BUENOS AIRES EXHIBITION—SPECIAL ANGLO-SPANISH NUMBER.

The Engineer.

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PUBLIC NOTICES

Civil Service Commission.

FORTHCOMING EXAMINATION.—NON-ESTABLISHED DRAUGHTSMAN in the Ministry of Agriculture and Fisheries (18-25, with extension in certain cases).

Regulations and particulars, together with the forms on which applications must be made, will be sent in response to requests (preferably by postcard), addressed to the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1, GIVING THE TITLE OF THE SITUATION. The latest date for the receipt of application forms is 7th May, 1931. 6815

Crown Agents for the Colonies.

COLONIAL GOVERNMENT APPOINTMENTS.

APPLICATIONS from qualified candidates are INVITED for the following POST :—

M/2628.—CIVIL ENGINEER REQUIRED by the GOVERNMENT of BRITISH GUIANA for three years' service as DIRECTOR of PUBLIC WORKS, with possible extension. Salary £1200 a year. Free passages. Candidates, aged 40 to 50, who must be Members of the Institution of Civil Engineers and preferably also Members of the Institution of Mechanical Engineers (or in lieu of the latter have suitable knowledge and experience in mechanical engineering as applied to hydraulics), must be capable of taking charge of the administration of a Public Works Department. The work is primarily that which would be undertaken by an Irrigation Engineer. Preference will be given to a candidate with practical experience in the reclamation of low-lying areas, river training work and the keeping of tidal channels free from silt.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, and mentioning this paper, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/2628. 6822

The Government of Bengal

invite APPLICATIONS for an APPOINTMENT as CHIEF INSPECTOR of SMOKE NUISANCES, Bengal. Candidates must hold a first-class, preferably an extra first-class, Board of Trade Certificate, or have obtained equivalent Degree or Diploma in Engineering, preferably Fuel Engineering, of a University or Technical College. In addition, they must have thorough knowledge of the Designing, Constructing, Operating and Testing of all classes of Industrial Furnaces, of the use of Solid and Pulverized Fuels, of Oil Fuels, and Gas, and of the scientific Reduction of Smoke and discharge of Soot, Ash, Grit, etc., and also of increasing efficiency in the Combustion of Fuel and the subsequent Utilisation of Generated Heat. They must also possess administrative experience. Age not more than 45 years.

Appointment on probation for two years, whereafter, if satisfactory, confirmation in Bengal Smoke Nuisances Service on a permanent pensionable basis. Pay at rate of Rs. 900, rising by annual increments of Rs. 50 to Rs. 1100 a month, plus, in the case of a candidate of non-Asiatic domicile, sterling overseas pay of £15 a month. In addition motor car allowance of Rs. 150 a month, travelling allowances, provident fund. Candidate of non-Asiatic domicile will be granted free first-class passage to India and on confirmation certain leave passages during service for self and family. Strict medical examination. Further particulars and forms of application may be obtained (upon request by post-card) from the HIGH COMMISSIONER FOR INDIA, General Department, India House, Aldwych, London, W.C. 2. Last date for the receipt of applications 30th April, 1931. 6825

The High Commissioner

for India is prepared to receive APPLICATIONS for an APPOINTMENT as ASSISTANT EXECUTIVE ENGINEER in the permanent Engineering Service of the Federated Shan States, Burma. The appointment will be subject to confirmation at the end of a probationary period of two years. Candidates should preferably be between 22 and 24 years of age and unmarried. They must either (1) have obtained a University Degree in Civil Engineering, or (2) have passed Sections A and B of the A.M.I.C.E. Examination, or (3) have passed the Associateship in Civil Engineering of the City and Guilds Institute (Imperial College of Science and Technology), or (4) have obtained the Diploma of Faraday House, London, or (5) have obtained such other Diploma or Distinction in Engineering as may be considered acceptable in any particular case. In addition they must have had at least one year's practical experience of Civil Engineering under a qualified civil engineer. Those whose qualifying diploma has been obtained without a college course should have had a full three years of such practical experience.

Pay in accordance with age scale, e.g., age 23, Rs. 375 a month plus overseas pay of Rs. 150 a month; age 24, Rs. 425 a month plus overseas pay of Rs. 150 a month; the scale rises to Rs. 975 a month plus £30 a month. (Approximate sterling equivalent at current rate of exchange £472, £517, £1237 per annum.) In addition, local compensatory and travelling allowances and Provident Fund. Free first-class passage to Burma. Strict medical examination. (Overseas pay and passage is admissible only to an officer of non-Asiatic domicile.) The climatic conditions of the Federated Shan States are suitable for Europeans, the temperature being cooler than that of Burma proper, and the climate healthy. Further particulars and forms of application may be obtained upon request by postcard from the HIGH COMMISSIONER FOR INDIA, General Department, India House, Aldwych, London, W.C. 2. Last date for receipt of applications 25th April, 1931. 6810

BRADFORD EDUCATION COMMITTEE.

Technical College, Bradford.

APPLICATIONS are INVITED for APPOINTMENT as LECTURER in METALLURGY in the College. Applicants should possess an Honours Degree, industrial and research experience in metallurgical work, and preferably a knowledge of modern foundry practice.

The salary offered is according to the Burnham Technical Award. The commencing salary for a candidate with a good degree and not less than 6 or 7 years' suitable qualifying experience in teaching and practice, would be about £340 per annum, rising by increments of £15 to £480 per annum.

Further particulars of the appointment and forms of application may be obtained from the Director of Education, Town Hall, Bradford, and completed forms should be returned to the Principal of the College not later than 30th April, 1931.

THOS. BOYCE,
Director of Education.
6801

The Engineer

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PUBLIC NOTICES

Armstrong College,

NEWCASTLE-UPON-TYNE.
(IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.Sc. and the HONOURS DEGREE of B.Sc. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.

Full particulars of the Courses may be had on application to

THE REGISTRAR,
Armstrong College,
6289 Newcastle-upon-Tyne.

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, TEMPORARY ASSISTANT, Assoc. M. Inst. C.E., for outside work. Must have experience in Reinforced Concrete.—Address, stating age and full experience, and enclosing copies of testimonials, P968, The Engineer Office. P968 A

A LARGE and Well-known FIRM of ENGINEERS in the Eastern Counties REQUIRE a WORKS MANAGER for their General Engineering Department. First-class training as a Mechanical Engineer, as well as experience in Works Management and Organisation, are essential qualifications.—Address, stating age, experience, salary required, and when disengaged, 6805, The Engineer Office. 6805 A

PUBLIC NOTICES

University of Liverpool.

FACULTY OF ENGINEERING.

DEAN: Professor G. E. SCHOLES, M.B.E., M.Sc., M.I.A.E., M.I. Mech. E.

The University awards the Degrees of B.Eng., M.Eng., D.Eng., Ph.D., and a Certificate and Diploma in Engineering.

Degree candidates must pass an approved Matriculation Examination. Certificate candidates must submit evidence of having received a good general education. Diploma candidates must possess the Certificate in Engineering.

The Courses are designed for students desiring to qualify as MECHANICAL, ELECTRICAL, CIVIL, or MARINE ENGINEERS, as NAVAL ARCHITECTS and METALLURGISTS or METALLURGICAL ENGINEERS. The Courses cover the subjects of examination for Associate Membership of the Institutions of Civil, Mechanical and Electrical Engineers. The Institutions named, subject to certain conditions, accept the Degree of B.Eng. in lieu of part, and in some cases the whole, of the examinations for Associate Membership. The various Departments are housed in commodious and well-equipped buildings, and provide ample facilities for research.

A prospectus of the Faculty, giving particulars of Courses and a large number of Entrance and Post-graduate Scholarships, may be had on application to the undersigned.

EDWARD CAREY,
6797 Registrar.

Newbury Corporation Water Undertaking.

TENDERS FOR WATER PIPES.

The Newbury Corporation invite TENDERS for :—(A) 6000 LIN. YARDS of 6in. Internal Diameter and (B) 3200 LIN. YARDS of 3in. Internal Diameter British Standard Class "B" CAST or SPUN IRON SPIGOT and SOCKET PIPES. Pipes to be coated inside and out with Dr. Angus Smith's Solution and delivered in truck loads at Kintbury Station (G.W. Rly.).

Sealed Tenders, endorsed "Water Pipes," must be addressed and delivered to the undersigned not later than Saturday, the 18th April, 1931.

The Corporation does not bind itself to accept the lowest or any Tender.

S. WIDDICOMBE,
Town Clerk.
Municipal Buildings, Newbury,
1st April, 1931. 6800

PUBLIC NOTICES

Administrative County of London.

BRIDGES—PAINTING WORKS.

The London County Council invites TENDERS for the CLEANING, PAINTING, &c., of
1. ALBERT BRIDGE.
2. WANDSWORTH BRIDGE.

The specification, form of Tender, &c., in respect of each work may be obtained on application to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1, upon payment in each case of £1 by cheque, draft or money order to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the works may be obtained on personal application and the contract documents may be inspected before payment of the fee.

Remittances by post should be addressed to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1. Personal inquiries at Room 2, No. 3, Warwick House-street, Cockspur-street, S.W. 1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in "The London County Council Gazette."

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 27th April, 1931, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX,
6799 Clerk of the London County Council.

Metropolitan Water Board.

COVERED SERVICE RESERVOIR AT PLUMSTEAD COMMON, WOOLWICH.

The Metropolitan Water Board invite TENDERS for the CONSTRUCTION of a COVERED SERVICE RESERVOIR in Mass and Reinforced Concrete, having a capacity of approximately 1¼ million gallons, at Plumstead Common, in the Metropolitan Borough of Woolwich, in the County of London.

The work will be carried out under the conditions prescribed by the Unemployment Grants Committee.

The drawings and contract documents may be inspected without charge at the offices of the Board, Chief Engineer's Department (Room 201).

Forms of Tender, conditions of contract, specification, and bills of quantities, together with drawings and a spare copy of the bills of quantities, may be obtained on and after Monday, 20th April, 1931, from the Chief Engineer, on production of an official receipt for the sum of £10, which must be deposited with the Accountant to the Board and which will be returned on receipt of a bona fide Tender accompanied by all the above-named documents and drawings (with the exception of the spare copy of the bills of quantities, which may be retained by the tenderer). Such payments and applications must be made between the hours of 10 a.m. and 4 p.m. (Saturdays, 10 a.m. and 12 noon). Cheques must be made payable to the Metropolitan Water Board and not to individuals.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Plumstead Common Reservoir," must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Wednesday, 13th May, 1931.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.
Offices of the Board,
173, Rosebery-avenue, E.C. 1,
31st March, 1931. 6818

Porthcawl Urban District

COUNCIL WATERWORKS.
CONTRACT NO. 7.
TO MANUFACTURERS OF WATER FILTRATION PLANT.

The Urban District Council are prepared to receive TENDERS for the SUPPLY of a complete WATER FILTRATION PLANT, to be erected in buildings which will be constructed at the site of the Ty-Coch Service Reservoir near Porthcawl, Glamorganshire.

The works included in the contract consist of the manufacture and erection of three filter units with coagulating plant and all accessories capable of treating and filtering the raw water at the rate of 15,000 gallons per hour, in accordance with drawings, general conditions and specification prepared by the Engineers, Messrs. John Taylor and Sons, Caxton House, Westminster, S.W. 1.

Copies of the general conditions, specification and form of Tender may be obtained by the contractor at the office of the Engineers upon payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender.

Tenders, in sealed envelopes, endorsed "Tender for Filtration Plant," are to be delivered at my office, Council Offices, Porthcawl, Glam., on or before 10 a.m. on Tuesday, the 21st of April, 1931.

The Council does not bind itself to accept the lowest or any Tender.

(Signed) EVAN DAVIES,
Clerk to the Council.
Council Offices,
Porthcawl, Glam. 6795

SITUATIONS OPEN (continued)

WANTED by Provincial Omnibus Company Owning a fleet of 800 machines, ASSISTANT ENGINEER. Must be fully conversant with complete overhauls, repairs, running defects, and latest workshop practice. Also able to institute economical systems. State full experience with technical training, age, and salary required.—Address, P944, The Engineer Office. P944 A

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PUBLIC NOTICE

North Riding of Yorkshire
COUNTY COUNCIL.
HIGHWAYS AND BRIDGES DEPARTMENT.
APPOINTMENT OF ENGINEERING ASSISTANT.

APPLICATIONS are INVITED for the APPOINTMENT of an ENGINEERING ASSISTANT at a salary of £400 per annum and allowance for use of motor car.

The appointment will be subject to the provisions of the Local Government and Other Officers' Superannuation Act, 1922, and will be terminable by one month's notice on either side. The selected candidate will be required to pass a medical examination.

Applicants must have had considerable experience in the design and construction of Highway Bridges. Experience of Road Improvement Schemes will be an advantage. Candidates should be Associate Members of the Institution of Civil Engineers or hold an equivalent University Degree.

Applications on the prescribed form (which can be obtained from the undersigned), together with copies of not more than three recent testimonials, should be forwarded to the undersigned, endorsed "Engineering Assistant," not later than 25th April, 1931.

HUBERT G. THORNLEY,
Clerk of the County Council.

County Hall, Northallerton,
31st March, 1931. 6792

SITUATIONS OPEN (continued)

WANTED, SURVEYOR, with Extensive Experience in Surveys for Overhead Electrical Transmission Lines, to Take Charge of Surveys, Levelling, Setting Out, etc., on Large Contract.

Apply in first instance, giving experience and references. State salary expected.

Address, 6827, The Engineer Office. 6827 A

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Full theoretical and practical experience essential.

Age, qualifications, copies of references and salary expected.

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WORKS MANAGER.—APPLICATIONS are INVITED from MEN capable of Taking Entire Charge of the Design, Estimating, Drawing-office and Workshops producing Riveted and Welded High and Low-pressure Chemical Plant, Storage Tanks, Hydraulic Pressings, &c. Only men who have shown first-class results and with wide experience in up-to-date methods are requested to apply in writing, giving full details (which will be treated as confidential) of previous experience, age, salary required, to MANAGING DIRECTOR, G. A. Harvey and Co. (London), Ltd., Woolwich-road, S.E. 7. 6821 A

WORKS MANAGER REQUIRED, with Actual experience of organisation on modern lines of a large engineering works of approximately 2000 hands, including proper use of pre-planning and progressing departments.

Address, stating experience, age, salary required, 6816, The Engineer Office. 6816 A

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A LARGE FIRM of ENGINEERS in the East Midlands REQUIRE a FOREMAN of about 30-35 years of age to Take Charge of and Develop the Structural Steel Department.

Applicants must have a sound theoretical and practical training and also experience of modern welding methods as applied to the fabrication of structural details.

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QUALIFIED COMMERCIAL ENGINEER, with office in Westminster and expert knowledge of steam plant design, erection and sales, with connection amongst steam users, is OPEN to REPRESENT first-class FIRM.—Write, Box E.E. 681, Rays, Cecil-court, W.C. 2. P970 D

MISCELLANEOUS

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References exchanged.

Address in first instance, P963, The Engineer Office. P963 I

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BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY,
22, Shakespeare House, 29-31, Oxford Street, W. 1. P955 I

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Belt-driven POWER DRAWING PRESS, by Kynochs Ltd., 2½in. stroke, with thread roller. £50

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ROBINSON 15in. by 6in. Five Cutter PLANING and MOULDING MACHINE, Ball Bearings throughout. Price £250.

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Mr. SHARP, KERR STUART'S LOCO. WORKS, WHIELDON ROAD, STOKE-ON-TRENT.

For continuation of For Sale Advertisements see page 68.

Spencer-Bonecourt Patent Waste Heat Boilers.
Broadway Bldgs., Broadway, Westminster, S.W. 1.

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FORCED DRAUGHT
FURNACES & STOKERS
for Maximum Efficiency, Low Upkeep & Smoke-cure.
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STEAM TURBINES
For Industrial Drives

CRANES
Derrick & Overhead Travelling Cranes
Worked by Hand, Power, and Electric.
JOHN SMITH (Keighley), LTD.
See last week's advertisement, page 56.

BRAMHALL CENTRE CO.
FOR LATHE CENTRES
any size and Taper, also revolving centres.
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SUPERHEATERS FOR ALL TYPES OF BOILERS.
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See Advt.—"Engineer"—April 3.

LEEDS ENGINEERING & HYDRAULIC CO., LTD.
RODLEY, Nr. LEEDS.
See large advertisement in last week's and next week's issues.

A Seven-Day Journal

A New Water Supply Works.

ON Tuesday, April 7th, Miss Megan Lloyd George opened new water supply works at Rhosneigr, in Anglesey. The development of Anglesey has been much retarded in the past by the lack of a good supply of water. Unfortunately, there are no large catchment areas and the majority of the streams run practically dry in summer. In 1906 the water supply to Rhosneigr began to receive attention, and in 1909 boring operations were started, but after the borehole had been sunk 600ft., its yield was found to be insufficient for the requirements of the district. Attention was next directed to the possibility of obtaining an upland surface supply from Bodswran, 6 miles away. A contract was let and delivery of the pipes had actually started when the war broke out and work had to be stopped. Later, it was found financially impossible to carry out this scheme. In November, 1923, the Council instructed Mr. Henry C. Adams, M. Inst. C.E., who was at the time engineer for the sewerage works, to prepare a scheme. His scheme has now been carried out. The water is obtained from Llyn Maelog, which is fed by a stream rising at Bodswran, and the flow off the gently sloping ground which surrounds the lake on three sides. It is believed also that there is a large spring in the bed of the lake. Pasture and agricultural land surround the lake, and in consequence the water is likely to be tainted with organic matter. In addition, the lake is "common land," the public having free boating, shooting, and fishing rights. Hence the water is hardly suitable for drinking in its original state, and a complete and efficient system of filtration and purification has therefore been installed. The method by which the water is drawn from the lake is interesting. A tunnel has been bored underneath the bed from a well at one side. The water percolates into this tunnel through its bed, which consists partly of rock and partly of gravel, and in its passage is freed from much of the matter held in suspension.

H.M.S. Tiger.

IN a Journal note in our issue of March 20th, we recorded the fact that H.M.S. "Tiger" was to be withdrawn from service in preparation for her destruction and sale. In the *Morning Post* last Tuesday, April 7th, a letter from Admiral Sir Henry B. Pelly appealing for a reconsideration of the decision was published. The Admiral states that he had the honour of commanding the ship from 1914 to 1916, and that he believes her to be still a most valuable asset to the British Navy. He considers it desirable that British fuel should be used in British ships, and points out that we are now practically dependent on overseas fuel. The "Tiger" was and still remains the "most all-round efficient ship" that ever was built, particularly because she can burn both coal and oil. The Admiral suggests that she might be kept as a training ship, so that the art of handling coal may be kept alive. In an article that follows the letter, comparison of the characteristics of H.M.S. "Tiger" and H.M.S. "Repulse", a ship built two years later than the "Tiger," is made, and we add here some figures, as given by Jane :—

	"Tiger."		"Repulse."
Tonnage (fully loaded) ..	35,000	..	36,800
Armament ..	8—13·5in. & 12—6in.	..	6—15in. & 15—4in.
Horse-power	108,000 for 30 knots	..	112,000 for 31·5 kn's
Fuel	4900 tons coal and oil	..	4243 tons oil only

At economical power the "Tiger" burns 220 tons of coal per day and the "Repulse" 180 tons of oil. We may add in this connection that a deputation from the mining industry will shortly invite the Board of the Admiralty to reconsider the fuel question in the Navy.

A New Steamer for the L.M.S. Larne-Stranraer Service.

LAST week saw the placing in commission of the new turbine steamer "Princess Margaret," which has been specially designed for the Larne-Stranraer cross-Channel service of the London, Midland and Scottish Railway. The new ship has a length of 325ft., with a beam of 47ft., her moulded depth and draught being 17ft. and 11ft. respectively. The twin-screw propelling machinery is of the Parsons single-reduction geared type, steam being raised in 225 lb. pressure coal-fired Babcock and Wilcox water-tube boilers. The turbines have been designed for a trial speed of over 20 knots. Arrangements are made for the accommodation of about 1250 passengers, and a large proportion of single-berth cabins have been provided. Over 40,000 cubic feet of cargo space is available, with modern loading and unloading gear. With the introduction of the new steamer a new train service from Glasgow to Stranraer has been put on, which enables passengers to leave Glasgow at 8 p.m. and arrive at Stranraer Harbour at 10.57 p.m., thus ensuring a full night's rest on the boat, which arrives at Larne early the following morning. A further improvement in connection with the new steamer is the recent erection at Stranraer of a portable electrically-driven coaling plant, designed by the Ritchie Atlas Engineering Company, Ltd., of Glasgow, which enables the steamers to be bunkered in about 45 minutes, instead of 2 or 3 hours, which were previously required when buckets and cranes were employed. The new plant is operated by two men only, and by its use practically all the noise and dirt associated with the usual coaling operations has been eliminated. The bunkering usually takes place at night, immediately after the boat train has left, and the plant is of such a type that when not in use it does not obstruct the quay in any way.

The Shipbuilding Industry.

SPEAKING after the launch of the new L.N.E.R. paddle steamer "Jeanie Deans" at the Govan yard of the Fairfield Shipbuilding and Engineering Company, Ltd., on Tuesday last, Sir Alexander Kennedy, the chairman of the company, referred to the present position of the shipbuilding industry. During the last six months there had, he said, been less than a quarter of a million tons of new shipping ordered. At present three-quarters of our shipbuilding berths were unoccupied, and so far as he could see there was little sign of an improvement. Contrary to the criticisms made by recent writers in this country and abroad, he did not think that the idea of eclipsed industry and eclipsed enterprise in this country was a true one. It was, he believed, fundamentally wrong, and they in the West of Scotland, were not likely to succumb to any such feeling of fatalism. At no time in its history had the shipbuilding industry given so much individual and collective thought as it was now giving to competitive capacity, and he thought that it was true to say that all the industry could do to put its own house in order would be done. As soon as British shipowners who, after all, were the most experienced shipowners in the world, felt that an improvement in outlook was taking place, then the shipbuilding industry would begin to move slowly upwards. The point of time for such imaginative anticipation might not yet have arrived, but a fall in the prices of primary commodities did look like coming to an end, and he hoped that the turn of the tide was not too far distant. The "Jeanie Deans" is a 257ft. paddle steamer of 540 gross tons, designed for a speed of 18¼ knots. Her namesake was built some forty-eight years ago, but had only half the tonnage of the new steamer, and was propelled by a single-cylinder diagonal paddle engine, with a jet condenser, steam being supplied by a haystack boiler working at 45 lb. pressure. She was one of the last paddle steamers with the old raised quarter deck built on the Clyde, and had a reputation for speed.

The Approach to Southampton Water.

THE 52,000-ton Cunard liner "Berengaria," which went aground in thick fog on the Boulder Bank, about four miles east of the Nab Tower, Isle of Wight, at a quarter to one on Tuesday afternoon, was safely berthed at Southampton on Wednesday afternoon. An internal examination of her hull revealed that the damage sustained was very slight, and it was decided that she shall make her scheduled voyage to New York to-morrow, Saturday, April 11th. The ship went aground on the mud bank both fore and aft, and although her engines were run astern for some time, the assistance of six tugs at high tide was required to get her off the bank, the process being assisted by a re-trimming of the oil fuel and ballast tanks. The accident is the second of its kind which has happened to Cunard liners this year, the "Mauretania" having previously gone ashore on one of her return voyages. These events have given point to the recent demands of the Southampton seafarers' organisations that some kind of directional wireless equipment should be installed at Nab Tower, so that incoming ships can, even in fog, take their bearings. At the present time the approaches to Southampton Harbour are, we are given to understand, only marked by sound signals, which include a fog horn on the Nab Tower and a submarine signalling bell on the Nab end buoy. There is no sound signal between the Nab Tower and the Warner Lightship, and from that ship to the Calshott Lightfloat there is no sound signal other than a submarine bell on the South End Middle buoy. With the advent of the new 1018ft., 73,000-ton Cunard liner in 1933, it seems very desirable that the position with regard to the approach to Southampton Water should be carefully reviewed in the light of the most recent navigational signalling developments.

Long Distance Wireless Telephony.

THE successful wireless telephony calls that have been made between London and Bombay, to which we referred in our issue of March 27th, are being followed by arrangements in India for a public service. The necessary arrangements in this country are complete, and will be available immediately the authorities in India are ready to inaugurate a service. Negotiations are also in progress for opening a public service between England and New Zealand. Following the official tests early this year, there were successful conversations between London and the Dominion at the time of the earthquake, when the Post Office provided special facilities. Preparations have been made for a wireless telephone service between England and South Africa, and the Post Office will be ready to make the preliminary tests immediately the station at Johannesburg has been equipped for that purpose. Arrangements are also said to be well advanced for opening a service between England and Egypt, whilst wireless telephone tests are being continued between this country and Japan. Telephone communication is thus being rapidly extended between remote parts of the British Empire and other countries of the world.

Motor Boat Speed Record.

IN a Journal note on Friday, March 27th, we recorded the fact that the American Commodore Gar Wood was the first man officially to reach the speed of 100 m.p.h. on water when he raised the record speed to 102·155 m.p.h. Last Thursday, Mr. Kaye Don won the record back for England by driving Lord Wakefield's boat "Miss England II." at 103·49 m.p.h. His attempt on the record was made on the Parana River, at a point some two hours' journey from Buenos Aires. As no means of communication between the chosen course and the town existed, the public had to rely on information received by the wireless installations of the gunboats lying in the river. A number of trial runs in the morning were not highly successful, but after luncheon the engine was re-tuned, and Mr. Kaye Don made a dash downstream first and later upstream, and an average speed of 103·49 m.p.h. was attained. As a consequence of this successful attempt, Britain now holds the speed records for air, land, and water. In the air, Squadron Leader Orlebar achieved a velocity of 357·7 m.p.h. soon after the Schneider Trophy Race in September, 1929, and Sir Malcolm Campbell, improving upon Sir Henry Segrave's record, raised the land speed to 247·736 m.p.h. at Daytona last February.

Electricity in Mines.

FOR some time past unofficial tests on electrical mining apparatus have been carried out at the Sheffield University, but in view of the fact that the Secretary of Mines has decided to institute official safety tests, the work at Sheffield is to be discontinued. The official tests will be made on apparatus intended for use in mines where, although the normal conditions are considered sufficiently safe to permit the use of electricity, it is, nevertheless, necessary to take precautions against an explosion of fire-damp. Briefly, the object of the tests is to determine by actual explosion experiments whether the apparatus under test is flame-proof; in other words, to discover whether the design and construction are such as will prevent the ignition of a small quantity of fire-damp inside the apparatus giving rise to an explosion of fire-damp outside it. With the help of the Safety in Mines Research Board, a new testing station has been erected near Harpur Hill, Brixton, adjoining the Board's research station there, and it will be ready for working during the present month. Inquiries and applications for tests should be addressed to the Under-Secretary for Mines, Mines Department, Dean Stanley-street, Westminster, S.W. 1.

First Australian Air-Mail.

THE first Imperial Airways air-mail from England to Australia left the London air-station at 8.30 a.m. last Saturday, April 4th, in a 9-ton Armstrong-Siddeley air-liner, and is due at Port Darwin on April 19th, completing in 15 days a journey of 11,194 miles, which, by surface transport, would occupy 28 days. The aeroplane carried, in addition to the first Australian air-mail, the Indian and African mails, the combined load representing a total of approximately 50,000 letters, of which, roughly, 15,000 were for Australia. This flight represents the first of two experimental return air-mails which, by arrangement between the Post Office, Air Ministry and Imperial Airways, are to be flown between England and Australia. Proposals for a regular weekly air-mail, carrying letters from England to Australia in 11 or 12 days, have been submitted by Imperial Airways, and are now under review by the Governments concerned. The return mail for England is scheduled to leave Port Darwin on April 27th, and is due in London on May 14th. A second air-mail from England to Australia will leave London on April 25th, while a second return service will leave Australia on May 17th. The route followed by the first outward bound service to Australia is *viâ* Paris, Athens, Cairo, Baghdad, Karachi, Delhi, Calcutta, Rangoon, Singapore, and the Dutch East Indies to Port Darwin, Australia. At Port Darwin the air mail from England will be met by an aeroplane of the Australian "Qantas" Company, and flown across Australia to Sydney and Melbourne, Sydney being reached on April 22nd. It may be recalled that it is only eleven years since the pioneer flight between England and Australia was made by two Australian airmen, the late Sir Ross Smith and Sir Keith Smith, in a Vickers-Rolls-Royce biplane in twenty-eight days.

Buenos Aires Trade Exhibition.

No. V.*

JONES AND SHIPMAN, LTD.

JONES AND SHIPMAN, Ltd., of Leicester, are showing a range of drilling machines, a twist drill grinding machine, and three sizes of "Willson" lathes, besides various small tools. The whole of the electrical equipment has been provided by the British Thomson-Houston Company, Ltd., of Rugby.

In Fig. 43 we reproduce a photograph of the twist drill grinding machine. It is designed to obtain simplicity and accuracy of operation and the makers claim that correctly ground drills can be obtained without any special skill on the part of the operator. The drill holder is so constructed that, whatever the diameter of the drill, the correct point angle is given to it, while the clearance angle can be adjusted by rocking the top drill-holder slide in a swivel bearing. This is accomplished by a simple thumb screw adjustment. The back V rest is adjustable longitudinally on the slide and the tailstock, which can be rapidly clamped in any position, is fitted with a fine screw feed to the stop plate. An attachment carrying a diamond in an adjustable holder fixed to the wheel guards is used for truing the wheel, and can be swung clear when not in use. The machine shown is driven by an electric motor fixed to the base of the column, but machines for belt drive are also made.

Los señores Jones and Shipman, Ltda., de Leicester, muestran un surtido de máquinas de perforar, una cortadora de berbiquí, y tres tamaños de tornos "Willson," a mas de varias herramientas pequeñas. El conjunto del equipo eléctrico ha sido suministrado por la British Thomson-Houston Company, Ltda., de Rugby.

En la figura 43 reproducimos una fotografía de la fresadora o pulidora. Ha sido diseñada para

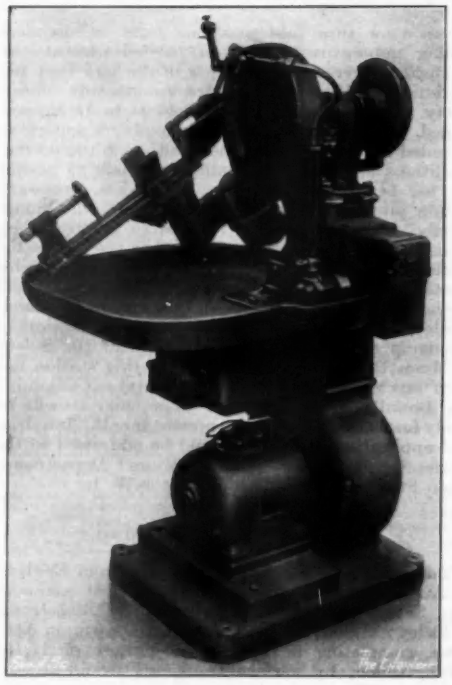


FIG. 43—TWIST DRILL GRINDING MACHINE—JONES

obtener simplicidad y exactitud en la operación y los fabricantes aseguran que se puede obtener mechas perfectamente cortadas y pulidas sin pericia alguna de parte del operario. El porta mecha está hecho de tal modo que cualquiera que sea el diámetro del berbiquí, se dará el ángulo correspondiente de punta, en tanto que el ángulo de juego puede ser ajustado moviendo el cursor del porta macho en su articulación universal. Esto se hace por medio de un simple ajuste a tornillo. El soporte en V de atrás puede ajustarse longitudinalmente en el cursor, y el cabezal que puede ser ajustado en cualquier posición, tiene un tornillo fino de alimentación. Un agregado que lleva un diamante en un mango ajustable fijo en las defensas se usa para centrar la rueda, y puede ponerse fuera de los movimientos cuando no está en uso. La máquina expuesta va movida por un motor eléctrico fijo en la base de la columna, pero también se fabrica máquinas para mando por correa.

J. AND E. HALL.

Three ammonia compressors form the chief point of interest in the exhibit made by J. and E. Hall, Ltd., of Dartford, Kent, who are also showing various refrigerating apparatus, such as ice cream conservators, ammonia condensers, &c. One of the compressors is a twin-cylinder, vertical, totally enclosed single-acting machine of the "Wembley" type. It is driven by an electric motor; has automatic control, and is fitted with a multi-tubular condenser. The whole makes one compact unit mounted on a single bed-plate. It has a capacity of 2·6 standard tons refrigeration.

A three-cylinder totally enclosed, single-acting, compound ammonia compression refrigerating machine, with a capacity of 31 standard tons refrigeration, is illustrated in Fig. 44. This machine has cylinder bores of 6in. and a stroke of 6in. The crank case is made of cast iron, strongly ribbed and it is fitted with three large inspection doors on each side. The cylinders are of close-grained cast iron and a water jacket is arranged round the tops of the cylinders, and the housing of the delivery valves. The cast iron pistons of the trunk type are fitted with four piston rings at the top and two at the bottom, with a suction port in the centre; the gudgeon pin is of hardened steel. The forged steel crank shaft is carried in three bearings and passes through a stuffing-box suitable for ammonia. Both suction and delivery valves are of the ring type, and each cylinder is fitted with a head mounted on substantial springs. If liquid ammonia finds its way into the cylinder, this arrangement acts as a safety device to prevent any damage being done. A safety disc, which will burst if the pressure becomes unduly high, is fitted in a connection between the suction and delivery branches and a large by-pass between the same pipes is arranged to facilitate easy starting. It will be seen that the hand wheels of the suction and delivery valves are so arranged that the wheel of the delivery valve overlaps that of the suction valve, preventing the opening of the suction valve before the delivery valve is opened.

The third machine shown by the firm is a vertical enclosed type ammonia compressor, arranged for belt drive.

Tres compresores para amoníaco forman lo mas importante de lo expuesto por J. and E. Hall, Ltda., de Dartford en Kent, los que también exponen varios aparatos para refrigeración, como ser conservadores para helados de crema, condensadores para amoníaco, etc. Uno de los condensadores es del tipo de cilindros gemelos, vertical, de acción sencilla, totalmente encerrado "Wembley." Va actuado por motor eléctrico; tiene control automático, y lleva un condensador multitubular. El todo forma un grupo compacto montado en una base de una pieza. Tiene una capacidad de 2,6 toneladas normales de refrigeración.

Una máquina para refrigeración de tres cilindros totalmente cerrados de acción sencilla, de compresión compound de amoníaco con una capacidad de 31 toneladas normales de refrigeración, se verá en la figura 44. Esta máquina tiene cilindros de 6″ (152,4 mm.) y carrera de 6″. El cigüeñal es hecho de hierro colado, reforzado con nervaduras fuertes, y provisto de tres amplias bocas para inspección en cada lado. Los cilindros son de hierro colado de grano fino y tienen adaptada en las culatas unas camisas de agua que también rodean las partes de las válvulas de descarga. Los pistones de hierro colado del tipo acofrado van provistos de cuatro aros de presión en el tope y dos abajo, con una boca de aspiración en el centro; el perno o cruceta es de acero templado. El cigüeñal de acero forjado va soportado por tres cojinetes y pasa a través de un prensa estopa especial para amoníaco. Tanto la aspiración como la descarga se produce por válvulas del tipo de aro, y cada cilindro está provisto de un cabezal montado en resortes sólidos. Si entrase amoníaco líquido en el cilindro, este aparato impide cualquier deterioro pués actúa como un seguro. Un disco de seguridad, que reventará si la presión es excesivamente alta, va adaptado en una conexión entre los ramales de succión y los de descarga y un amplio pasaje entre los mismos va para facilitar un arranque fácil. Se verá que los volantes de mano

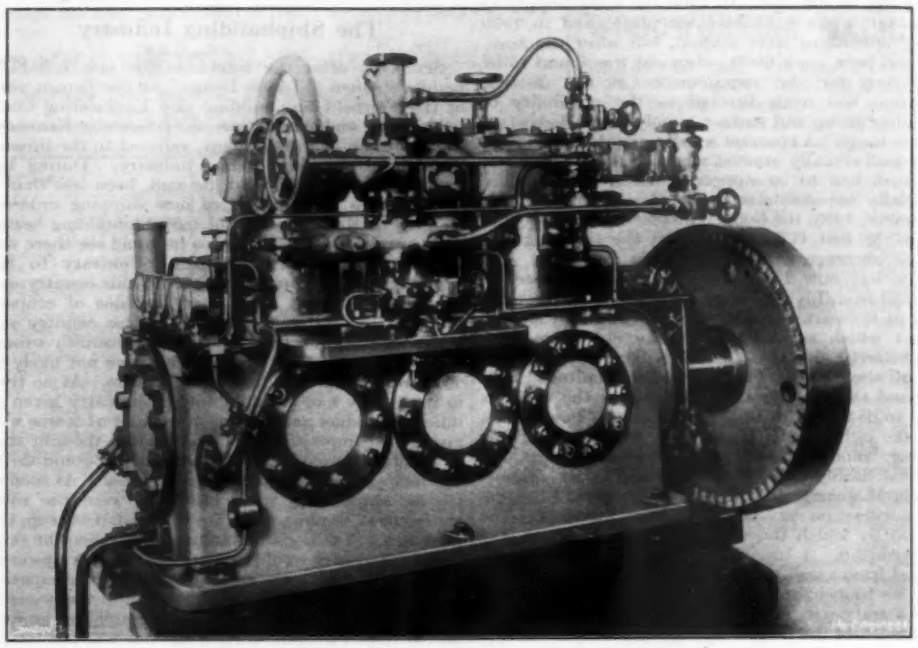


FIG. 44—THREE-CYLINDER AMMONIA COMPRESSOR—HALL

de las válvulas de aspiración y de descarga están arreglados de tal manera que la rueda de la de descarga sobrepasa la de succión, y evita así el abrir la aspiración antes de que se abra la válvula de descarga.

La tercera máquina expuesta por la firma es una vertical toda encerrada para comprimir amoníaco, movida por correa.

MIRRLEES, BICKERTON AND DAY, LTD.

The largest exhibit by Mirrlees, Bickerton and Day, Ltd., of Hazel Grove, Stockport, is the six-cylinder 450 B.H.P. Diesel engine shown in Fig. 48.

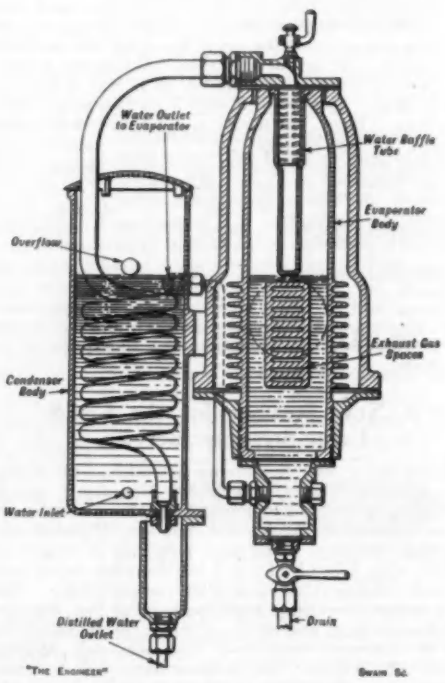


FIG. 45—DISTILLER—MIRRLEES

This unit, which is shown coupled direct to a 400-kW General Electric Company's dynamo, is of special interest, as it represents the fourth engine of the type which has been supplied to Biekert's Brewery (1900), Ltd., of Buenos Aires, where it will be installed after the close of the Exhibition. The engine is representative of the latest Mirrlees practice for land and marine use, and works on the four-stroke cycle with air injection. It has a cylinder bore of 13¾in. and a

* No. IV. appeared April 3rd.

stroke of 19in. and a designed running speed of 300 r.p.m. As the illustration shows, the crank case is totally enclosed. The lubrication of the main bearings, crank pins and gudgeon pins is effected through drilled passages under oil pressure and the gudgeon pins are of the floating type with the bearings specially designed to give an increased bearing area. The pistons are independently lubricated by Mirrlees sight-feed lubricators, a feature of which is that the oil is sighted on the delivery side of the plunger and shows the actual amount fed to the part. The three-stage air compressor is mounted on the bed-plate and is driven from the crank shaft. At the top of the vertical shaft, driving the cam shaft, a governor of the centre sprung type is mounted, with

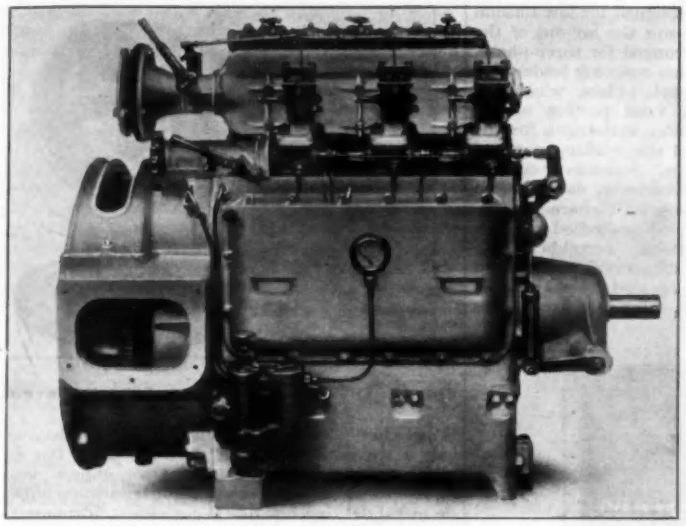


FIG. 46—60 B.H.P. SLEEVE VALVE ENGINE—MIRRLEES

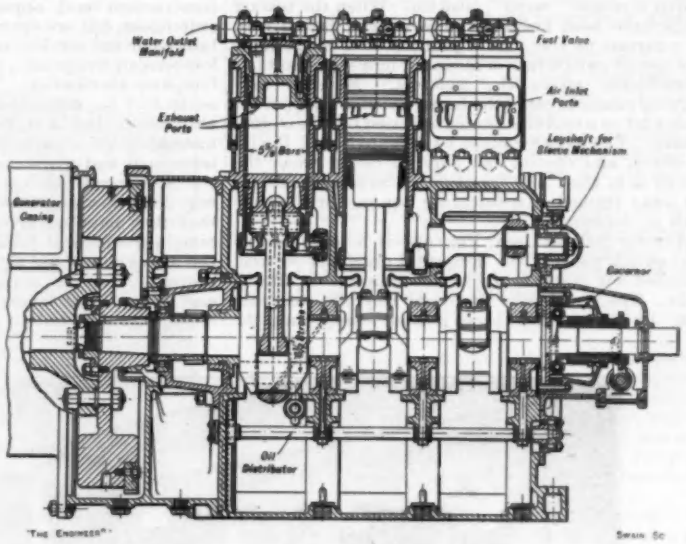


FIG. 47—SECTION THROUGH SLEEVE VALVE ENGINE—MIRRLEES

ball bearings at all the points at which there is any relative movement. A hand special regulating gear is also provided. As exhibited on the stand, the engine will be slowly rotated by a small electric motor through a friction drive.

Another interesting exhibit is the Mirrlees-Ricardo three-cylinder airless injection 60 B.H.P. 1200 r.p.m. sleeve-valve engine, which we show in section, and also by an outside view in Figs. 46 and 47. This engine, which is shown working at its normal running speed, is coupled to a 40-kW D.C. generator, by Metropolitan-Vickers. It has a bore of 5⅜in. and a stroke of 6½in. and, as our drawing indicates, the single sleeve valve eliminates both air and exhaust valves, the air being entrained and the gases exhausted through appropriately shaped ports of large area. The absence of valves enables the best shape of combustion speed to be obtained with a peripheral fuel jet giving that ordered turbulence which is essential to good combustion. By means of sectional models driven by a small electric motor the action of the sleeve and its driving mechanism and also of the fuel pump are clearly demonstrated. A feature of the design, which is indicated in Fig. 47, is the very simple method by which the generator casing is secured to the fly-wheel housing of the engine. By this means it is possible to adopt a single bearing generator and no lining up is required, as the casings are self-aligning. These engines are standardised in two sizes of cylinder with outputs of 20 and 50 B.H.P. per cylinder, the smaller cylinder size being made in three to six-cylinder units with outputs from 60 to 120 B.H.P., and the larger cylinder size in three to eight-cylinder units with outputs from 150 to 400 B.H.P.

In many oil engine installations a supply of pure distilled water is essential for battery make-up water, delicate work, or chemical processes. To meet this requirement a special distiller heated by exhaust gases has been evolved by the firm. It is shown in section in Fig. 45, and, as shown, is built into the exhaust pipe so that the hot gases pass through the evaporator which is connected to a coil type condenser in which the steam generated is again converted into water. Suitably arranged baffles are used to prevent any water passing over with the steam. It is designed for exhaust pipe diameters of 5in. to 12in. bore and can be fitted in the exhaust system of any internal combustion engine.

El renglón mayor expuesto por los señores Mirrlees, Bickerton y Day, Ltda., de Hazel Grove, en Stockport, es el motor de seis cilindros de 450 caballos Diesel que se ve en la figura 48. Este grupo, que se muestra acoplado directamente a un dinamo de 400 kW de la General Electric Company, es de especial interés, pués representa la cuarta máquina de este tipo que ha sido entregada a la Cervecería Bieckert (1900), Ltda., de Buenos Aires, donde será instalada al cerrarse la Exposición. El motor representa lo mas moderno de Mirrlees para uso marino y terrestre, y trabaja a cuatro ciclos con inyección de aire. Tiene un cilindro de 13¾" de alma (349,25 mm.) y una carrera de 19" (482,6 mm.) y una velocidad calculada de trabajo de 300 revoluciones por minuto. Como lo indica la figura, el carter es totalmente cerrado. La lubrificación de los cojinetes principales, muñones del cigüeñal y crucetas de los pistones, se efectúa por medio de pasajes perforados bajo presión de aceite y las crucetas son del tipo libre con los cojinetes diseñados especialmente para que proporcionen un área aumentada de soporte. Los pistones van enaceitados separadamente por aceiteras de émbolo a la vista Mirrlees, un detalle digno de notarse en ellos es que el aceite es visto en el lado de la descarga del émbolo y muestra la verdadera cantidad que se manda a esa parte. El compresor de tres etapas va fijado en la base y es accionado por el cigüeñal. En el extremo superior del eje vertical que manda el eje de levas hay un regulador del tipo a resorte central con cojinetes de bolas en todos los lugares en que hay algún desplazamiento relativo. También se provée de un mecanismo de regulación a mano. En la Exposición, el motor será movido lentamente por medio de un motor cito eléctrico y una transmisión a fricción.

Otro artículo interesante es el motor Mirrlees-Ricardo de tres cilindros de inyección sin aire de 60 caballos a 1200 r.p.m. con válvulas de manguito o de corredera, que mostramos en sección, y también en una vista lateral, en las figuras 46 y 47. Este motor, que se muestra trabajando a su velocidad normal de trabajo, está acoplado a un generador de 40 kW de corriente contínua, por la Metropolitan-Vickers. Tiene un alma de 5⅛" (126,5 mm.) y una carrera de 6½" (165,1 mm.), y como lo indica nuestro grabado, la corredera o manguito o camisa elimina las válvulas de admisión y las de escape, pués el aire entra y los gases salen por los agujeros de forma apropiada y de amplia sección. La ausencia de válvulas permite la mejor forma de velocidad de combustión obtenible con un chorro periférico de combustible que produce esa turbulencia o remolinos esenciales para una buena combustión. Por medio de modelos seccionados movidos por un motorcito eléctrico se muestra la acción de la corredera y su mecanismo de mando así como también el de la bomba de combustible. Un rasgo del diseño, que está indicado en la figura 47, es el método sencillísimo de asegurar la cubierta del generador a la cubierta del volante del motor. Por este recurso es posible adoptar un generador de cojinete sencillo sin que se necesite centrado interno, puesto que las cubiertas se alínean solas. Estos motores van fabricados en dos tamaños de cilindros con rindes de 20 y 50 caballos por cilindro, el tamaño mas pequeño es suministrado en grupos de tres a seis cilindros con rindes de 60 a 120 caballos, y los cilindros grandes en grupos de tres a ocho cilindros con rendimientos de 150 a 400 caballos de fuerza. En muchas instalaciones de motores a petróleo, una provisión de agua destilada es esencial para rellenar baterías, trabajos delicados o procedimientos químicos. Para llenar estos requisitos un aparato especial para destilación calentado por los gases del escape ha sido inventado por la firma. Se verá en sección en la figura 45, y, como se ve, está hecho incorporado en el caño de escape para que los gases calientes pasen por el evaporador que está unido a un condensador de serpentín en el que el vapor producido se convierte de nuevo en agua pura. Unas trampas dispuestas convenientemente impiden el pasaje de agua alguna junto con el vapor. Está calculado para diámetros de caños de escape de 5" a 12" (127 a 304,8 mm.) y puede adaptarse al sistema de escape de cualquier motor de combustión interna.

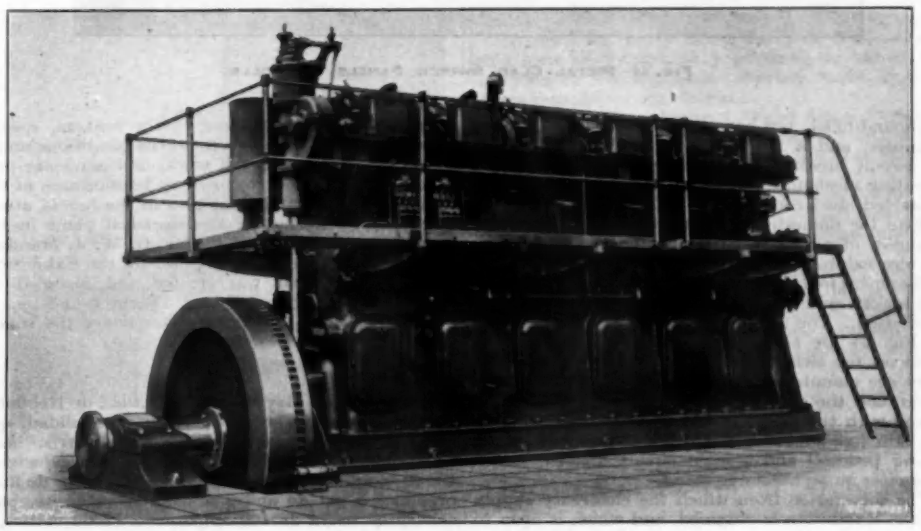


FIG. 48—450 B.H.P. DIESEL ENGINE—MIRRLEES

A. REYROLLE AND CO., LTD.

Representative products, including power station, sub-station and industrial switching equipments, are being shown by A. Reyrolle and Co., Ltd., of Hebburn-on-Tyne. An exhibit of special interest is an oil-immersed ring main isolating switch, suitable for currents up to 400 ampères at 12,000 volts, and fitted with a tee-off switch fuse. These isolators have been specially developed to provide an economical means of tapping high-tension lines in rural or other sparsely populated areas for supplies to small consumers.

They are said to provide adequate protection to consumers' plant, and as the equipment is completely weatherproof and floodproof, a housing is unnecessary. The unit comprises two oil-immersed isolating switches to enable it to be connected to or isolated from the main supply line, as well as the tee-off circuit through the switch fuse. The operating handles—for each isolating switch—are outside the tank, and can be set to the "on," "off," or "earth" position. Interlocks ensure correct operation and a definite stop is provided on the handle at the "off" position, so that it cannot be swung direct from the "on" position to the "earth" position. The interlock must be deliberately released by hand before the "off" position can be passed. Testing terminals are provided on the side of each ring main cable box, but the orifices are not accessible unless the switch is in the "earth" position. When the testing plugs have been inserted, however, the switch may be returned to the "off" position, but no further. The tee-off switch fuse is mounted in a separate tank immediately above the isolators. Movable self-aligning contacts carry the fuses, which are supported from a lid on a movable frame, operated by an external handle. The switch cannot be operated until the lid is closed, and the lid can only be closed when the switch is in the "off" position. The tee-off cable is led away through a trifurcating box mounted at the back of the unit.

Another exhibit—see Fig. 49—is a large metal-clad switch panel of the horizontal draw-out pattern, designed for currents up to 400 ampères at 33,000 volts. The panel is of the usual Reyrolle construction, having a fixed back portion comprising the compound-filled bus-bar and current transformer chambers, and a movable portion, which supports the circuit breaker, the isolating contacts, and the operating mechanism. The supporting framework is of welded steel construction. Metal-clad plugs and sockets for domestic and industrial uses and some examples of air-break switch-and-fuse combinations are also exhibited. The illustration, Fig. 50, shows a 30-ampère four-pin, three-phase, weatherproof plug and socket, with an additional safety earth-scraping connection. The switch-and-fuse equipments shown in Fig. 51 are suitable for 660 volts, and can be arranged for either two-pole or three-pole circuits. They are mounted in robust weatherproof cast iron boxes, and the external operating handles are interlocked with the lids. In addition to these exhibits, the firm has supplied control gear consisting of an exciter pedestal and a main circuit breaker for an alternator on an adjoining stand.

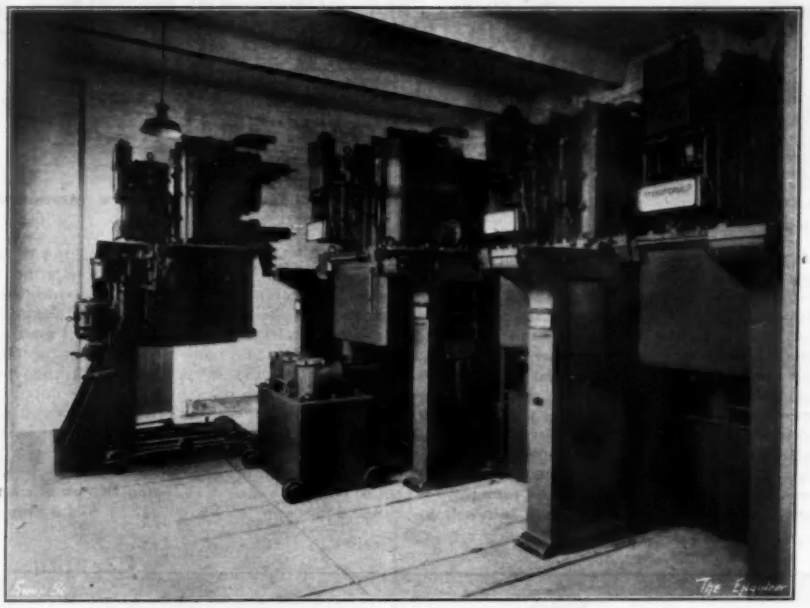


FIG. 49—METAL-CLAD SWITCH PANELS—REYROLLE

The sub-station from which the electricity supply for the Exhibition is obtained, and which is open to the public, is equipped with Reyrolle high and low-voltage switchgear. The incoming supply is derived from a 13,500-volt, three-phase, three-wire system, and is stepped down through four 500-kVA transformers for supplying the 380/220-volt, three-phase, four-wire distribution network in the Exhibition, and the high-voltage and low-voltage switchgear mentioned is provided for controlling the incoming and outgoing feeders. The whole of the switchgear is metal clad. The high-voltage equipment consists of a six-unit board, including two incoming feeder panels and four transformer panels controlling the 13,500-volt side of the transformers, the switchgear being of the horizontal draw-out type, arranged for direct manual operation. Each panel consists of two main portions, namely, a fixed back portion which contains the bus-bar and current transformer chambers and the supporting framework, and a movable portion which includes the oil-immersed circuit breaker. The bus-bar chambers of each panel are compound filled, and the bus-bar sections are connected to each other, so as to form a continuous bus-bar along the board. The current transformer chambers are also compound filled, and house the current transformers provided for the operation of ammeters and overload protective devices. Contact sockets in the fixed portion, which engage with self-aligning plug contacts in the movable portion, are mounted and insulated from each other in deeply recessed orifices, and locking-off doors, operating automatically, cover and prevent access to the sockets on the withdrawal of the movable portion.

The low-voltage board consists of thirteen panels, nine of which control the outgoing feeders, whilst the remaining four control the low-tension side of the transformers. The transformer panels are similar in construction and appearance to the high-voltage switchgear, but are specially designed for low-tension heavy-current service, and to suit the lay-out of the low-tension equipment, are arranged for three-phase, four-wire distribution. The nine outgoing feeders are controlled by 400-ampère switch pillars, which are also metal-clad and have a fixed portion and a movable portion capable of being withdrawn for the inspection and maintenance of the working parts of the oil-immersed circuit breaker. Series over-current trip coils operate in conjunction with dashpots, so that they have an inverse time limit characteristic. Simple mechanical interlocks are embodied in both the high-voltage and the low-voltage switchboards to prevent incorrect sequence of operation, and red and green signal lamps are provided on each panel to indicate the position of the switch. In accordance with the standard practice of the makers, special consideration has been given to the conditions under which the switchgear will work, and adequate provision has been made to prevent deterioration of the secondary wiring and insulation in the humid atmosphere. The lay-out of the electrical plant in the Exhibition was arranged by Mr. G. W. J. Munday, local consulting electrical engineer for the Exhibition, and the switchgear was erected and installed by Reyrolle's local agents, Evans, Thornton and Co., of Calle Defensa, 465, Buenos Aires, under the supervision of Mr. A. L. Lovill.

Los señores A. Reyrolle y Cía., Ltda., de Hebburn-on-Tyne, exponen artículos de su especialidad, que incluye instalaciones para fuerza motriz, subestaciones, y tableros de distribución para industrias. Un objeto de interés especial es un disyuntor de línea principal o red de anillo sumergido en aceite, para corrientes hasta de 400 amperios a 12000 voltios, y provisto de un fusible para disyuntor de ramales. Estos aisladores han sido proyectados especialmente para permitir un medio económico de conectar líneas de alta tensión en sitios rurales o de escasa población para suplir clientes de poco consumo. Se dice que ofrecen protección adecuada a la instalación del consumidor, y como el equipo es completamente a prueba de agua y de inundación, no hace falta protegerlas con cajas o garitas. La unidad comprende dos disyuntores de aislación sumergidos en aceite para permitir conectarla o aislarea de la línea principal, incluido el circuito del ramal a través del fusible del disyuntor. Las manijas de mando-para cada interruptor-están fuera del tanque y pueden ser puestas en las posiciones "contacto," "corta," o "tierra." Unos cerrojos de intertrabar aseguran una maniobra correcta y una detención definida va fija en la manija para la posición "corta," de manera que no se la pueda mover directamente de la posición "contacto" a la posición "tierra." La traba ha de sacarse deliberadamente con la mano antes de que se pueda pasar la posición "corta." Hay terminales de prueba en cada lado de la caja de los cables del circuito de anillo, pero los orificios no son accesibles a menos que el aparato esté en la posición de "tierra." Cuando se inserta los enchufes de prueba, sin embargo, el disyuntor puede ser puesto en la posición "corta," pero no mas allá. El fusible del disyuntor del ramal va montado en un tanque separado que está inmediatamente encima de los aisladores. Unos contactos móviles de alimeamiento automático soportan los fusibles, los que a su vez van sostenidos por la tapa de un marco movedizo, accionado por la mano, por una manija exterior. El disyuntor no puede moverse hasta que la tapa esté cerrada, y la tapa solo se puede cerrar cuando la manija esté en la posición "corta." El cable del ramal o derivación sale a través de una caja de trifurcación fija en la parte trasera de la unidad. Otro objeto, vea la figura 49, es un gran tablero de distribucuión cubierto de metal del tipo horizontal corredizo, calculado para corrientes hasta de 400 amperios a 33000 voltios. El panel es del tipo usual de Reyrolle, con una parte trasera fija que comprende la barra colectora rodeada de composición aisladora y las cámaras de transformación de corriente, y una parte móvil que soporta al cortacircuito, los contactos aislantes, y el mecanismo de maniobra. El bastidor soporte es de acero soldado. Se expone también algunos tapones recubiertos de metal y enchufes para usos domésticos e industriales y algunos ejemplos de combinaciones de corta-circuito y fusible al aire libre. La figura 50, muestra un tapón y enchufe para 30 amperios con cuatro clavijas trifásico a prueba de agua, con un aditamento especial para una toma de tierra de seguridad. Los juegos de tapón y fusible que se ve en la figura 51. se usan para 660 voltios, y pueden ser arreglados sea para circuitos de dos polos, sea para tres polos. Van montados en cajas robustas de fundición impermeables y las manijas exteriores de mando van intertrabadas con las tapas. A mas de estos objetos, la firma ha suministrado el mecanismo de control para un alter-

FIG. 50—THREE-PHASE PLUG & SOCKET—REYROLLE

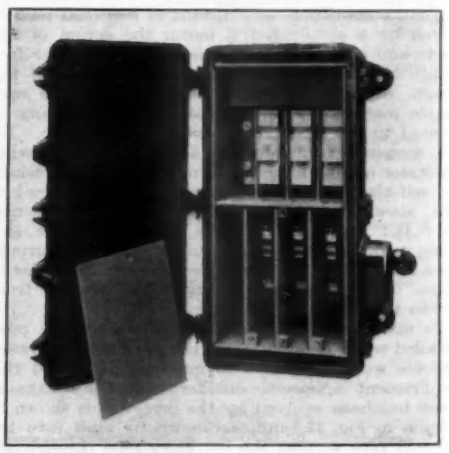


FIG. 51—SWITCH AND FUSE EQUIPMENT—REYROLLE

nador de un pabellón adyacente, que consiste en un pedestal excitador y un corta circuito principal.

La subestación que provée la electricidad para la Exposición, y que el público puede visitar, está provista de tableros de distribución para alta y para baja tensión de Reyrolle. La corriente de entrada proviene de un sistema de tres hilos, de 13500 voltios, trifásico, reducido por medio de transformadores de 500 kVA para dar corriente a la red de distribución de la Exposición, de cuatro hilos trifásica de 380–220 voltios, y el equipo arriba mencionado para alta y baja se usa para controlar los alimentadores de entrada y de salida. Todo el mecanismo va revestido de metal. El equipo para alta tensión consiste en un cuadro de seis unidades, incluidos dos paneles para alimentadores de entrada y cuatro paneles para transformador que controlan el lado de los 13500

voltios de los transformadores, todo el sistema es del tipo horizontal de quitaypón, arreglado para maniobra a mano, directa. Cada panel consiste de dos partes principales, a saber; una parte fija atrás que lleva la barra colectora ómnibus y las cámaras transformadoras y el marco de soporte, y una parte móvil, que incluye el cortacircuito sumergido en aceite. Las cámaras de la barra ómnibus de cada cuadro están rellenadas de composición aisladora, y las secciones de la barra selectora están conectadas entre ellas, de modo de formar una barra contínua a lo largo del tablero. Las cámaras de los transformadores de corriente también van rellenas de aislación, y alojan a los transformadores provistos para accionar los amperómetros y artefactos para proteger contra cargas excesivas. Los enchufes para contactos de la parte fija que reciben los machos o tapones de alineamiento automático, de la parte movible, van fijados y aislados entre ellos en agujeros profundamente hundidos; y unas puertas con cerradura que operan automáticamente, cubren y evitan el acceso a los enchufes al sacarse la porción móvil.

El tablero de bajo voltage consiste en 13 paneles, 9 de los cuales controlan los alimentadores de salida, en tanto que los 4 restantes controlan el lado de baja tensión de los transformadores. Los paneles de los transformadores son semejantes en construcción y en apariencia a los de alta tensión, pero son hechos especialmente para corrientes muy poderosas de baja tensión, y, para adaptarlas al sistema del equipo de baja, están arreglados para distribución trifásica, por cuatro hilos. Los 9 alimentadores de salida van controlados por pilares disyuntores para 400 amperios, los que están también recubiertos de metal y tienen una parte fija y una móvil que puede sacarse para inspección y mantenimiento de las partes activas del cortacircuito sumergido en aceite. Unas bobinas de disparo para sobrecarga obran en combinación con amortiguadores, de manera que tienen un tiempo característico límite para invertir (interruptor retardado). Unos mecanismos sencillos para trincar o intertrabar van incorporados en los cuadros de alta y en los de baja tensión para evitar una secuencia incorrecta en la operación o maniobra, y unas lámparas de señales rojas y verdes van en cada panel para indicar la posición del disyuntor. De acuerdo con la práctica normal de los fabricamentes, se ha prestado atención especial a las condiciones en que trabajará el cuadro de distribución, y se ha provisto lo adecuado para evitar deterioro del enrollado secundario y aislación en una atmósfera húmeda. El proyecto de la instalación eléctrica en la Exposición fué presentado por el señor G. W. J. Munday, ingeniero electricista consultor local para la Exposición, y los cuadros han sido armados e instalados por los agentes locales de los Sres. Reyrolle, los señores Evans, Thornton y Cía., calle Defensa número 465, Buenos Aires, bajo la dirección de señor A. L. Lovill.

JOHN FOWLER AND CO. (LEEDS), LTD.

Among the exhibits by John Fowler and Co. (Leeds), Ltd., of Leeds, we have chosen for illustration the 8-ton oil engine-driven road roller shown in Fig. 52. It is of the three-roller pattern with large diameter rolls giving a wide overlap. The engine is of the cold starting high-speed heavy-oil type working on airless injection, and the makers claim that the fuel cost is only about one-third of that of a similar roller using petrol and is equal to or even less than that of a steam road roller. The roller is furnished with an immediate acting reverse gear which is operated by two simple toggle clutches which are carried outside the frame. All controls are neatly arranged in the driving cab and inspection doors give access to the engine. Power steering is arranged for and is driven from the cross shaft, the controls being mounted on the steerage column, the change-over from hand to power steering being effected by moving a small lever below the steering wheel. A differential gear is fitted and the roller carries water spraying equipment. As shown by our illustration, the driver is protected by an awning.

Another Fowler exhibit comprises a concrete mixer with an upright drum. The speed arrangement of the drive is claimed to reduce the weight on the tractor wheels, while the lubrication has been very carefully designed with a view to economical running. The mixer is driven by a Petter oil engine.

In Fig. 53 we illustrate a little Samson rail tractor for 24in. gauge, built by Fowlers, which is recommended as a simple and economical shunting locomotive for contractors' work. The engine and transmission gear is carried at the centre of the tractor platform with a chain drive to both axles. The bearings are fitted with pressure lubrication throughout, and there are brakes to all wheels. There are two control levers, one for the forward and the other for the reverse gears, which are clutch operated, and also a brake handle. The rail tractor we have described is designed to haul 30 tons on the level or 10 tons up a gradient of 1 in 50.

Entre los artículos expuestos por los señores John Fowler y Cía, Ltda., de Leeds, hemos elegido para muestra el aplanador de petróleo de 8 toneladas para calles que se ve en la figura 52. Es del tipo de tres rodillos con rodillos de gran diámetro que dan un ancho recubrimiento. El motor es del tipo de aceite pesado de arranque en frío, con inyección sin aire, y los fabricantes aseguran que el costo del combustible es solo de un tercio del de otro que use nafta y es igual o talvez menor que el de uno de vapor. El aplanador está provisto de un mecanismo de marcha atrás de acción inmediata que obra por medio de dos palancas acodilladas de embrague que van en los lados de afuera del armazón. Todos los controles están netamente arreglados en la cabina del conductor y hay puertas de inspección para revisar el motor. El manejo mecánico está dispuesto en el eje y está mandado desde él, con los controles en la columna de dirección, haciéndose el cambio de uno a otro manejo por medio de una palanquita que está debajo de la rueda o volante de dirección. Tiene mecanismo diferencial y el aplanador lleva un equipo para rociar con agua. Como lo muestra

FIG. 52—8-TON OIL ENGINE-DRIVEN ROAD ROLLER—FOWLER

nuestra figura, el conductor va resguardado por una marquesina.

Otro renglón de Fowler comprende un mezclador de concreto con un tambor vertical. El arreglo de la velocidad de mando se dice que reduce el peso en las ruedas del tractor, mientras que la lubrificación ha sido cuidadosamente proyectada para que trabaje económicamente. El mezclador es accionado por un motor Petter de aceite.

En la figura 53 mostramos un pequeño tractor para rieles Samson para trocha de 24" (60,96 cm.), construido por Fowlers, el que se recomienda como una locomotora sencilla y barata para cambios, en trabajo de contratistas. La máquina y mecanismo de transmisión va en el centro de la plataforma del tractor con una cadena motora para ambos ejes. Los cojinetes tienen lubrificación forzada en todas partes, y hay frenos en todas las ruedas. Hay dos palancas

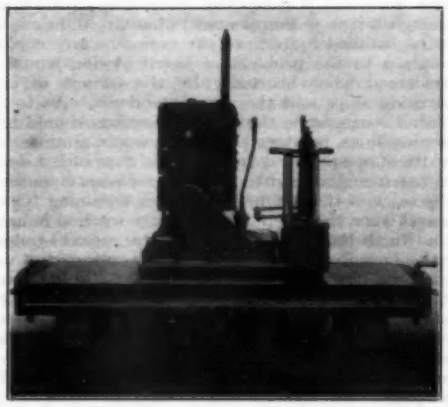


FIG. 53—24IN. GAUGE RAIL TRACTOR—FOWLER

de mando, una para marcha adelante, y la otra para la contramarcha, accionadas por embragues, y también una manija para freno. El tractor para rieles que hemos descripto está calculado para arrastrar 30 toneladas a nivel o diez toneladas en una rampa de 1 en 50.

VALVES, JOINTING MATERIALS AND VARIOUS.

Sir W. H. Bailey and Co., Ltd., of Manchester, are exhibiting gyrometers and tachometers, air compressors and reducing valves. The Foster type valve, the makers claim, is capable of reducing in one stage from any high initial pressure to atmosphere and can be regulated for any delivery pressure between that and 15 per cent. of the inlet pressure.

Richard Klinger, Ltd., of London, is showing a number of types of valves and cocks. The valves have no seatings. The hand wheel actuates a piston moving through two flexible rings. A slotted cage fits between these rings, and the piston covers or uncovers the slots.

Gun-metal cocks and valves and fittings for steam oil or water form the exhibit of Pegler Brothers and Co., Ltd., of Doncaster.

Newman, Hender and Co., Ltd., of Woodchester, besides a large variety of cocks and valves and pipe fittings, are showing some types of semi-rotary pumps, lift and force pumps, and appliances for use with fire hydrants, &c.

Newalls Insulation Company, Ltd., of Washington, Durham, and Turner Brothers, of Rochdale, are both showing their specialities in packing and insulation materials. Thomas and Bishop, Ltd., of London, are showing their "Permac" jointing material and "Flexo" tinning compound, and James Walker and Co., Ltd., of London, their "Lion" packing and "Golden Walkerite" jointing.

The firm of Henry Robb, Ltd., of Leith, is showing a number of photographs and paintings of ships constructed at its yard. These range from lighters and tugs to dredgers.

Various types of railway signalling and other safety devices are shown by the Westinghouse Brake and Saxby Signal Company, Ltd., of London. The exhibits will be shown at work.

The firm of Crompton Parkinson, Ltd., of Aldwych, London, has no stand of its own, but a number of motors and fans which it has made are in use on other stands.

Richardsons, Westgarth and Co., Ltd., of West Hartlepool, are showing photographs of a number of typical products and installations, including condensers, boilers, a 750 kW oil engine-driven generating set, and marine steam and oil engines.

Sir W. H. Bailey & Co., Ltd., de Manchester, exponen medidores de vueltas y de velocidad, compresores de aire y válvulas de reducción. La válvula de tipo Foster, según los fabricantes, puede reducir en una etapa desde cualquier presión inicial alta a la atmosférica y puede ser regulada para cualquier presión de descarga entre esa y 15% de la presión de entrada.

Richard Klinger, Ltd., de Londres, expone un surtido de tipos de válvulas y grifos. Las válvulas son sin asientos. El volante de mano acciona un pistón que se mueve entre dos anillos flexibles. Una jaula con hediduras va justa entre esos anillos, y el pistón cubre o descubre las aberturas. Grifos de bronce para cañones, válvulas y accesorios para vapor o agua forman lo expuesto por los señores Pegler Brothers & Co., Ltd., de Doncaster.

Los señores Newman, Hender & Co., Ltd., de Woodchester, a mas de una variedad de grifos y válvulas y piezas para cañería, exponen algunos tipos de bombas semirotativas, bombas para ascensores y para presión, y aparatos para usar con bocas para incendio, etc. Los señores Newalls Insulation Co., Ltd., de Washington, en Durham, y Turner Brothers, de Rochdale, exhiben ambos sus especialidades para empaquetaduras y aislación. Thomas & Bishop, Ltd., de Londres, exponen sus materiales "Permac" para juntas, y "Flexo" para estañado y James Walker & Co., Ltd., de Londres, exponen su empaquetadura "Lion" y material para juntas "Golden Walkerite."

La firma de Henry Robb, Ltd., de Leith, expone una serie de fotografías y pinturas de barcos construidos en sus astilleros. Varían desde lanchitas hasta remolcadores y dragas.

La Westinghouse Brake & Saxby Signal Company, Ltd., de Londres, expone varios tipos de señales para FF. CC. y otros aparatos de seguridad. Los aparatos se verán funcionando.

La firma de Crompton Parkinson, Ltd., de Aldwych, Londres, no tiene escaparate propio, pero gran número de sus motores y ventiladores funcionan en los diferentes pabellones.

La firma Richardsons, Westgarth & Co., Ltd., de West Hartlepool, expone fotografías de un número de sus productos típicos e instalaciones, incluyendo condensadores, calderas, un grupo generador de 750 kW movido por aceite crudo, y motores marinos de vapor y de aceite crudo.

(To be continued.)

Institution of Naval Architects.

No. III.*

THE third paper to be taken on the morning of Thursday, March 26th, was one by Mr. L. C. Burrill on "Seaworthiness of Collier Types," a summary of which is given below.

SEAWORTHINESS OF COLLIER TYPES.

This paper is a report on the principal work upon which the author was engaged during his tenure of the Research Scholarship, awarded by the Commissioners of the 1851 Exhibition, to which he was appointed by the Council in October, 1927.

The main work undertaken was to study the seaworthiness of collier types by actual observations at sea under winter conditions, recording the conditions of wind and sea, and observing the angles of roll and pitch and the amount and position of shipped water. It was decided at the outset to limit the investigation to ships between 200ft. and 300ft. in length, the majority of colliers plying in the North Sea and English Channel falling between these two limits of length.

During the early months of 1928 and the winter of 1928–29

* No. II. appeared April 3rd

twenty-six voyages were made in eight ships of different types, principally in the North Sea and English Channel, Bristol Channel, and round the French coast to the Bay of Biscay, whilst in one instance a voyage across the Atlantic to Canada was made in a small raised quarter-deck collier having engines aft, with a subsequent voyage on the Great Lakes. Voyages with coal, grain, and china clay cargoes, and voyages in ballast condition were included. The paper gives a full description of the ships tested and the observations made, with tables, curves and drawings.

As a result of the experience of the behaviour of the ships in various sea conditions, and of the analysis of the stability data recorded in the paper, the following general conclusions are drawn :—

1. *Sufficiency of G.M.*—The safety of normal colliers would not be materially increased by increasing the metacentric height above the average values stated.

2. *Freeboard.*—Any increase of safety as may be deemed necessary should be provided rather by increasing the freeboard and thus increasing the range of stability without increasing the initial stiffness.

3. *Seaworthiness and Optimum G.M.*—In the case of stiff ships having a rolling period of from 7 to 8 seconds for complete oscillation there is some possibility of an approach to synchronism with the short waves encountered in the North Sea. On the other hand, ships having a natural rolling period of 11 to 12 seconds roll more easily, but individual heavy seas are more apt to break over a slow-moving ship than a quick-moving ship.

An optimum rolling period would be about 9 to 10 seconds. With normal ships this would correspond to an optimum value of S of about 1·40 to 1·50, corresponding to a G.M. of about 1·5ft. in ships about 200ft. long and a G.M. of 2·3 in ships about 300ft. long.

4. *Hatch-closing Arrangements.*—The only real solution to this very vital problem will be the introduction of some form of steel hatch covers for this type of ship.

5. *Personnel.*—The fact that the number of colliers lost in recent years has decreased is a tribute to the great care and vigilance of the officers and crew in keeping their ships in seaworthy condition, and especially to the foresight of the masters, who have to decide when to "heave-to," shelter from, or "run" before the heavy weather frequently encountered in the North Sea and English Channel during the winter months.

Professor Percy A. Hillhouse said he was much interested in the author's new criterion of stability. It was a great improvement on the bare statement of metacentric height. The author had chosen that percentage of the vessel's weight, which, if moved transversely through the full breadth of the ship, would cause her to list to an angle of 15 deg. The fifteen vessels of which particulars were given in Table I., however, had all very small freeboards, and in all cases their deck edges would be immersed at much smaller angles—the average, except vessel G, being about 3 deg. A given angle of heel was less serious in a narrow vessel than in a broad one, because it lowered the deck edge by a lesser amount and he suggested that perhaps a better criterion of stability would be that percentage of the vessel's weight which, when moved transversely through the full breadth, would depress the deck edge 6in. Alternatively it was possible to take as criterion that percentage of the ship's displacement, which when moved transversely through the full breadth would bring the deck edge to the water line.

Professor W. Hovgaard said that the stiffness factor adopted by Mr. Burrill was very good and very ingenious ; it was decidedly of advantage to be able to deal with such a factor instead of with the pure metacentric height. It seemed to him, however, that the period of some of the ships was remarkably short ; some of them must have been very stiff and violently rolling ships. Again, it appeared that waves nearly 800ft. long were encountered in some cases, but such waves were quite unusual, even in the Atlantic.

Sir Westcott Abell said the paper was one of the first studies of the suitability of a particular type of craft to its particular environment. It had a distinct bearing on the freeboard question, since Mr. Burrill compared the results in service of vessels with different arrangements of superstructures, which were treated separately by the freeboard regulations. The work of Mr. Burrill suggested that in certain areas the seas and winds had certain characteristics. Mr. Burrill had said that the maximum waves encountered in the North Sea were from 150ft. to 200ft. long and from 10ft. to 15ft. high. Probably an average wave was about 250ft. long, and of less height than that referred to by Mr. Burrill. Probably a ship 250ft. long made the greatest average motion and a ship 400ft. long would be well above any chance of synchronism, except perhaps with a following sea.

Mr. E. F. Spanner, dealing with stability, said he was in favour of the adoption of the stiffness factor suggested by Mr. Burrill, and considered that a useful purpose would be served by advocating the establishment of a minimum value for that factor in the case of small vessels. He suggested that a suitable minimum value would be 1·5 at 15 deg. He was in substantial agreement with Mr. Burrill's method of arriving at a mean effective freeboard, and considered that it would be helpful to adopt a standard minimum value for the ratio F/H. A reasonable figure would be one-third. The setting down of minimum requirements in regard to those two factors would ensure that designers maintained a resonably safe standard in regard to initial stability and stability at large angles. At the same time, lack in either of those directions in existing vessels could not in itself be regarded as indicating that they were unsafe. On the other hand, the provision of the minimum requirements he had referred to would not in themselves ensure safety. That could be realised only if the various elements contributing to effective freeboard played their parts properly in developing the reserve of buoyancy which ensured stability at large angles. He was sorry Mr. Burrill had suggested that the only solution to the problem of closing the large hatchways which were essential in this type of craft would be the introduction of some form of steel hatch cover, and he suggested that the design of large hatchways using wooden covers could be improved very considerably without departing very much from normal practice by giving them a very heavy camber. The paper indicated that there should be no reason to anticipate loss of any small ship, no matter how bad the weather she experienced, provided only that she had a proper stiffness factor, sufficient effective freeboard, and proper arrangements for making her deck openings weather-tight. It also indicated that every one of the vessels in which Mr. Burrill had sailed might be lost if she should be sent to sea badly loaded, with defective hatch covers, with ventilators partly corroded away, with insufficient security for the end plugs of the ventilators against bad weather conditions, or with other faults in her weatherworthy equipment.

Mr. H. E. Steel said that, although one felt that a complete investigation into the seaworthiness of all types of colliers could not be made too soon, a wise decision was made when the class between 200ft. and 300ft. in length was chosen as the subject of Mr. Burrill's research. In most respects the author's deductions agreed with present-day opinions. It was necessary to emphasise, however, that, probably owing to lack of opportunity, a complete picture of existing colliers of the lengths under discussion was not given. He was grateful for the author's curves of G Z for well-deck ships. At the same time, they represented only what might be termed the "sea stability" for ships with good G.M.'s, *i.e.*, stability against temporary heeling. Shifting of cargo would modify them, and enclosed erections were not always free from flooding when a ship took a permanent list in heavy weather. All colliers did not possess such large G.M.'s. The author's blessing on vessels having deep ballast tanks alongside the tunnels should be qualified by a warning that increased proportions might be desirable for the maintenance of a suitable G.M. The suggested stiffness factor was an interesting development of Dr. Bruhn's suggestion made in 1927. Having regard to the manner in which G Z curves for small well-deckers dropped below the tangent line and the large inclinations necessary to immerse any part of their hatchways, the recommended optimum factors would probably require modification for vessels outside the limits of this paper.

Commander Anderson (Superintendent of Colliers, South Metropolitan Gas Company) said that the author's method of determining mean effective freeboard was novel, and on the generous side. From a purely seaworthy point of view he considered that the conventional method should govern design, assuming, of course, that ships of that type were still to be arranged as at present. Hatches were admittedly the greatest danger, and the present method of closing them could not by any means be claimed to be watertight. He considered that the platform from which freeboard should be determined was that taken from the main, *i.e.*, the statutory deck to the load line. With regard to hatch planks, he said that in his experience those at present fitted—about 10in. or 11in. wide and possibly 10ft. long—were quite heavy enough for an ordinary man to handle, and they had to be handled four times per voyage. Any efficient solution to the problem of hatch closing would be welcomed whole-heartedly by the owners of coal-carrying ships and the superintendents. As to the author's suggestion that hatch coamings should have sloping sides, he agreed that that would minimise the width of opening, but he was afraid that such a design of hatch might tend to leave larger empty spaces at the sides of the hatches in the self-trimming type of vessel when they were loaded by the method in use at the North-East Coast ports, *i.e.*, by means of chute, either gravity or belt conveyor. It was with a view to obviating such empty spaces that the hatches in such vessels were made as wide as was consistent with safety. Another objection was that the sloping side offered freer access of loose sea water to the underside of the tucked-in portion of the tarpaulin, thereby increasing the possibility of the tarpaulin being dislodged.

The practice of plugging air pipes leading to double bottoms was bad and should not be permitted. The fact that they were plugged was apt to be forgotten, and on that account serious damage sometimes resulted. The danger was not confined to collier types, as he had experienced it in battleships ; in both cases stresses were set up and distortion occurred. The method advocated by the author, *i.e.*, to end the pipes below deck in spaces always left empty, was satisfactory so far as tanks filled by gravity were concerned, but in the case of those pumped up—*i.e.*, aft peak fore peak, and deep tank in way of after hold—some form of water-tight closing should be adopted ; this should not give rise to danger, provided a good system was instituted on board and the number of people involved was limited. The carrying of the air pipes up the mast would place an extra stress on the tanks, and this factor would have to be taken into consideration in the design.

Mr. Burrill replied to one or two of the questions raised, but intimated that he would extend his reply in a written contribution.

Professor W. Hovgaard then presented a paper on "A New Theory of the Distribution of Shearing Stresses in Riveted and Welded Connections, and its Application to Discontinuities in the Structure of a Ship."

THE DISTRIBUTION OF SHEARING STRESSES IN RIVETED AND WELDED CONNECTIONS.

The method proposed in this paper for determining the stress distribution in riveted and welded connections is based on the assumption of continuity, such as found in continuous welds. It is believed to be applicable with fair approximation also to intermittent welds and to riveted connections where there is a great number of rivets in the line of strain, as in longitudinal girders and many other members of a ship's structure. In all such cases the intermittent shearing area is assumed to be spread out and distributed uniformly along the line of weld or rivets. A bar or girder of limited length attached to a major structure, which is subject to tension or compression in a direction parallel with the bar is first considered, and the solution worked out is then, directly or with small modifications applied to stiffeners, longitudinals, re-enforcements, and various erections, such as deck-houses, and used to determine also the approximate stress distribution in welded joints.

The theory presented shows that it is fundamentally undesirable—although often necessary—to attach relatively short longitudinal structures to the midship portion of the strength deck or the bottom plating of a ship. Formulæ are given which show that there will be a great concentration of shear at the ends of such girders, and the method of calculating the magnitude of the stresses at those points is indicated.

In order to avoid such stress concentration, all longitudinal girders and erections, connected to the strength deck or the bottom plating, should be as far as possible carried continuously forward and aft to points where the bending moments are always small. In longitudinals this feature may be associated with a considerable and gradual reduction in strength towards the ends. In case of deck-houses it appears that expansion joints generally aggravate the trouble, and the best remedy seems to be an increase of rivet area at the corners and suitable re-enforcements.

Large hatches in a strength deck produce discontinuities quite analogous to those produced by the sides of the deck-houses.

The theory corroborates the opinion generally held that the rivets in the outer rows of multiple-riveted joints are more highly stressed than those in the inner rows, and gives the law according to which approximately the stresses vary.

Mr. W. R. G. Whiting said that from the information contained in the paper it was possible to make something like a quantitative shot at what was happening at the ends of certain connections. That was useful, and the more commendable because the results were such as one had felt instinctively were right ; but previously one had not precise data with which to reinforce that instinctive opinion.

Mr. S. V. Goodall said it seemed that the broad conclusion Professor Hovgaard had reached might be summed up as being "the desirability of gradualness." He had deduced that Professor Hovgaard had proved mathematically that unless great care was exercised in the gradual termination of a doubling plate and its riveting at the ends, surprisingly high stresses would be brought into existence.

Mr. J. Foster King said that Professor Hovgaard's theory seemed to have direct relationship to actual cases, of which typical examples were unbracketed stiffeners on shell, double bottom, &c., but it must be remembered that the primary function of such girders was to resist bending under load between points of support, and therefore, did not comply strictly with the fundamental case in the paper. In his view such girders should be designed for their primary purpose, and although the longitudinal strains induced by the main plating could not always be ignored, they should not be designed with excess material to be regarded as contributions to the longitudinal strength of the main plating. He suggested that, instead of attempting to avoid excessive shear stresses by means of extra rivet area at the end of the connection of abruptly ended bars and girders of this order, it would be much better to taper the ends of the bar or girder so far back as to relieve the end rivets from excessive shear stress. He hoped that it might be possible for Professor Hovgaard to extend his theory so as to provide a comparative method which would cover the fact that every girder with free square ends which was attached to a main girder exposed to tensile and compressive strains was subject to shear stresses at its ends because of the abrupt change in girder section.

Dr. A. M. Robb suggested that Professor Hovgaard was in error when he referred to the possibility of the maximum bending moment being appreciably away from amidships. The importance of the paper was enormous, he continued, when one considered that every structural connection in a ship, apart from the simple butt joint, was subject to the kind of stress that Professor Hovgaard had dealt with. In the application of electric welding it would seem that the real problem was that of the edge connection, and we should probably find that many of our structural arrangements based on riveted connections were misleading.

Professor Hovgaard replied in detail to the various points raised by the speakers.

A paper on "Further Model Experiments on the Resistance of Mercantile Ship Forms : Coaster Vessels," was then presented by Mr. F. H. Todd.

MODEL EXPERIMENTS ON COASTER VESSELS.

This paper presents the results of some further methodical experiments on the resistance of ship forms made at the William Froude Laboratory. The particular type of ship covered by the series is the coaster vessel with a length of 400ft. between perpendiculars. The first part gives the results for a series of models representing coasters of varying beam, draught, and prismatic coefficients, all being made to the same parent form. A comparison is made to show the difference in power for a ship of constant displacement with proportions varied according to the series. The second part gives the results from another series of models, made to investigate the effect of any departure from the parent form, and these results are discussed with a view to determining what improvement is possible in the design of such vessels.

All the results given in the paper are in the form of circular C curves for a 400ft. ship. To enable them to be used for different

lengths of ship, an approximate method for obtaining the length correction is given in an appendix. Further research on coasters in connection with their propulsion is now being carried out at the William Froude Laboratory.

Dr. E. V. Telfer said that Mr. Todd's observations on the effect of the screw aperture in full stumpy single-screw forms were of first importance. A loss of from 12 to 14 per cent. in resistance, due to the aperture alone, appeared at first sight to be almost unbelievable. The loss, moreover, must be confined to the upper half of the aperture, since it was not a consequence of reduced absolute length as such, but was due to the rapid increase of curvature introduced at the upper levels. The majority of coaster and collier forms in the past had had pronounced V sections aft, and the present P series had that characteristic. From observations he had made at sea on that class of vessel, he could fully endorse Mr. Todd's figures of losses. Actually, the total loss was likely to be greater than that shown on resistance alone. Although Mr. Todd had made out a good case for the cruiser stern in the full model tested, Dr. Telfer was extremely doubtful whether that saving could be translated into an equal economy for an actual ship. For the ordinary slow-speed, single-screw merchant ship, in his experience, the best results were obtained with the ordinary cylindrical stern, but it would be interesting to have the results of Mr. Todd's further work on the propulsion of cruiser stern models.

Mr. G. S. Baker, Superintendent of the Froude National Tank, referring to the presentation of the experimental data as C curves, said that if anyone could suggest a better method of presentation, he would adopt it; it had stood the test of 30 years' use.

Mr. Todd, replying to Dr. Telfer, said that it was hoped to test the effect of the cruiser stern on some of the models.

The meeting was adjourned until Friday.

The President (Admiral of the Fleet the Right Hon. Lord Wester Wemyss, G.C.B., C.M.G., M.V.O.) was in the chair when the meeting was resumed on Friday morning, March 27th. The secretary announced the names of 136 new members, associate members, associates, students, and transfers, all of which were approved.

A paper by Dr. H. H. Blache, entitled "The Present Position of the Diesel Engine for Marine Purposes," was then read. This paper is given in an abridged form on page 411.

Engineer Commander C. J. Hawkes said that he had been particularly interested in the Burmeister and Wain system of supercharging. The paper gave some comparative figures for similar engines fitted with turbo-chargers and chain-driven rotary blowers and although there was some difficulty in following the figures, the author had indicated that the power required to drive blowers in the Burmeister and Wain system was nearly compensated for by the smaller negative work of the cycle. That undoubtedly was the case for the particular engines compared, but any comparison of that sort should be made with the best type of turbo-charged systems. About a year ago he supervised the trials of a North-Eastern Marine Company's engine fitted with the Buchi system, and the recorded mean pressure in the inlet and exhaust pipes at a B.M.E.P. of 125 were 19·4 and 18·2. With that difference between the mean inlet and exhaust pressures, namely, 1·2, one would not expect the negative work to be greater with the supercharged engine than with a similar engine non-supercharged, and, in fact, the light spring diagrams taken during the trial confirmed that. It would be interesting to know what power was required to compress the air which was drawn into the cylinder during the pre-inlet period. That air had to be compressed up to the supercharged pressure, and his own calculations for the power necessary were slightly higher than given by the author. It was extremely interesting to notice that Burmeister and Wain, following their pioneer work with the four-stroke engine, were giving attention to the two-stroke engine. With one exception, however, there was no mention in the paper of the single-acting two-stroke engine. Before the war many single-acting two-stroke engines up to 500 r.p.m. were constructed for submarines. Their weight was given as about 33 lb. per B.H.P., but after some experience, a number of them were made more robust and the final figure was not less than 50 lb., *i.e.*, about the same weight as the ordinary four-stroke engine of that date. The two-stroke submarine engines were, on the whole, not successful. It would be interesting to know why such a champion of the four-stroke engine, as the author, was developing the high-speed two-stroke engine, and what advantages he hoped to obtain from it over its older and well-tried rival.

Dr. W. H. Muller said he did not think we had yet got so far as to be able to agree with the author that the Diesel engine should be adopted when burning oil and the steam engine only when burning coal. In any comparison between the Diesel engine ship and the turbine-driven ship, one of the disadvantages of the former was that the vibration was more inconvenient than in the latter. It was rather surprising that the author had not mentioned one of the solutions to that problem in Diesel engine ships which had been adopted on a few vessels built in Holland and Germany, namely, the hydraulic gear-driven Diesel engine. This was the Vulcan gear which had been described in more than one paper.

Engineer Rear-Admiral Scott Hill said it appeared that the weight of Diesel engines had now been brought down to 144 lb. per B.H.P., and that compared very favourably with the weight of the most modern form of steam plant. As regarded fuel consumption, the Diesel engine might be expected to use 0·4 lb., including lubricating oil, the coal-burning modern steamship would use 1 lb. of fuel, and the oil-burning steamship 0·66 lb. of a cheaper grade of oil. As to the prospect for coal, the "Berwindlea" had steamed 57,000 miles in fourteen months on a coal consumption of 1·28 lb. That was the first ship specially intended for pulverised fuel, and it had cylindrical boilers with an ordinary pressure. We could hope, however, to see modern high-pressure steamships with pulverised coal bringing down their consumption to below 1 lb. with modern high pressures and effecting the same difference in wages costs as had been achieved with the Diesel engine vessel. From inquiries made two or three years ago, the price of Diesel machinery was approximately 25 per cent. above that of steam, and it would be interesting to be given the present relation by someone having close knowledge.

Mr. J. Hamilton Gibson said the author had concluded by stating that at the present stage of the marine Diesel engine it was adaptable for all types of ship from a 35 H.P. engine to a 20,000 H.P. plant, and also that the Diesel engine should—presumably always—be adopted when burning oil, and the steam engine when burning coal. But steam engineers could not accept such sweeping statements, however great the authority. The modern marine steam plant was also adaptable for all types of ships ranging from 2000 H.P. to 20,000 H.P. The author had been careful to refer to relative fuel costs and not fuel weights, which, he stated, were about 50 per cent. higher for steam than for corresponding marine Diesel plants. Previous papers by Sir John Biles and Mr. John Johnson and others did not admit 50 per cent.; it was nearer 20 per cent. His impression was that unless high-speed geared Diesels were put forward, steam plants—which, by the way, had still plenty in hand for further improvement—would continue to beat the clumsy direct Diesels on price, weight, and running costs.

Mr. Harry Hunter, referring to nomenclature, suggested that the proposal made by Mr. Lugt in Glasgow early this year, should be adopted, namely, that a Diesel engine whose cylinder is charged with air at a pressure in excess of the atmospheric pressure, be referred to as "super-atmospheric engines," and the normal engine as the "atmospheric engine." This nomenclature was the same as that adopted 150 years ago, when the Watt engine superseded the Newcomen atmospheric engine, and the position of the super-atmospheric Diesel engine to-day was so analogous that, perhaps, even the author would be agreeable to adopting the steam engine nomenclature of the eighteenth century. The analysis made by the author early in the paper of light spring cards from an exhaust turbo-charged engine and from a positively charged engine, suggested that the former was an unusually poor specimen, because the card indicated that the air and exhaust gases were very badly restricted in some way, either by valves or piping. In an exhaust turbo-charged engine, it was essential that the pipe leads to and from the cylinders and the valve areas, &c., should be carefully designed in a manner comparable to the care taken with pipe connections between turbines and the condenser in a steam plant, where every fraction of an inch of pressure drop was guarded. In an exhaust turbo-charged engine, with the gas flow conditions carefully guarded and running at higher speeds and higher mean pressures than those used in the "Agamemnon" and "Deucalion," a pumping loss of 1·65 lb. was found on tests carried out by Professor Hawkes. If that figure was used instead of the normal figure of 0·32 kilos. used by the author, we should find a pumping loss I.H.P. in the "Agamemnon" of 75 H.P., *i.e.*, slightly less than that found in the "Deucalion" engine. It seemed, therefore, that the "Deucalion" engine would be saddled with the extra 160 H.P. to drive its blower, or an additional 3 or 4 per cent. The figure found by Professor Hawkes was only one-third of that found with the "Agamemnon" engine, and if we took his figure of 0·116 kilos. (1·65 lb.), instead of 0·32 kilos., as found in the "Agamemnon," the whole of the author's argument was completely upset and the turbo-charged engine was some 5 to 7 per cent. superior.

Mr. W. Nithsdale suggested that the five reasons given in the paper in support of the motorship could surely be applied equally well to the modern steamship, if not more aptly. The first three reasons were certainly equally applicable, whilst, as for the fourth, the speed of an oil-fired steamship depended no more on manual labour than did that of a Diesel vessel. Again, the latest coal-burning ships were equipped with mechanical stokers, so that that reason did not have any bearing on modern practice. Nor was he able to agree with reason five, relating to simplicity, when one remembered the complicated cylinder fittings, valves, springs, cams and the multiplicity of moving parts and accessories of a Diesel engine. As regarded vibration, the turbine being a rotary engine, would always give smoother running than the Diesel engine, or, for that matter, any other form involving reciprocating motions. From Table III. it appeared that the average annual maintenance cost of the first five vessels was £·746 per I.H.P. for periods after nine years' service. On the other hand, the average of the two newest vessels was £·113 per I.H.P. yearly for their first three to five years' service. A possible interpretation, therefore, was that the maintenance costs of these motorships, after nine years' service, was 6½ times greater than that for the first two years. It would be useful to know the costs, of, say, the year 1922 and also 1930 for the five older vessels to see in what light the variation then appeared. Would the author give some information about the maintenance of Diesel vessels of 5000 S.H.P., which seemed to be the highest dealt with in the later tables in the paper, although it was stated that the engine was adaptable for all types of ship up to 20,000 H.P.? The shipowner was not concerned so much with fuel consumption expressed in pounds per S.H.P. as in pounds sterling per S.H.P., and the relative costs of boiler oil and Diesel oil accounted in part for the presence of high-pressure steam installations. Compared with Diesel engines, up-to-date steam machinery could be designed, in the majority of cases, for lower initial cost and less weight, to occupy no more space, and for lower fuel cost per S.H.P. It was, therefore, impossible to accept the author's view that the steam engine should only be adopted when burning coal.

Professor W. Hovgaard, speaking with regard to the strains which are apt to occur at the bed-plates and seatings of Diesel engines, asked for some information as to whether excessive strains and stresses had been noticed at the ends of bed-plates or seatings, especially in cases where they were not connected to the bulkheads and where they stood as separate structures on the inner bottom of the ship.

Mr. A. C. Hardy said the paper was specially to be commended because of the strong case it made of the fact that the Diesel engine was not expensive either in repair or in upkeep. Reference should be made to the publication last year of some very complete details concerning the working of the Runciman "Moor Line" fleet over a period of 38 months. These results showed that for a standard 8100-ton tramp ship over 38 months the repairs and maintenance were only at the rate of £14 6s. per month, and, for a sister ship, £16 5s. per month. There was also the case of a remarkably successful fleet of tankers, each propelled by a double-acting, four-cycle Diesel engine of about 3000 H.P., which, over a period of years, had operated practically without any major breakdown. One particular unit of that fleet recently made a 20,000 miles run from London to the Antarctic carrying fuel oil for the whaling stations, with no involuntary stop, either on the outward or homeward passage other than a 2-hours' call at Dakar for bunkers. Most of the ships of that fleet never spent more than 24 hours in port. The particular ship he had just mentioned, when it arrived back, required a total expenditure of only £350, which was due to minor propeller and shafting damage and not to the engines at all. That was an interesting operating record for double-acting, four-cycle engines, and it could be coupled with the fact that there were 26 passenger vessels in service with Harland and Wolff engines of that type and 12 vessels with Werkspoor engines of that kind. Operating results had proved that where properly handled and serviced, and even given a wide range of fuels, the Diesel engine gave no trouble. Whilst steam would always have a paramount interest in this country owing to our richness in coal, it should not be forgotten that our very richness in coal might prove ultimately to be the reason for the poorness of our representation on world trade routes.

Mr. J. H. Narbeth, referring to ventilation in relation to oil engines, said that CO was liable to collect in recesses in the middle and upper part of the engine-room, whilst petroleum gases collected in recesses below the engine-room platform. Therefore, whilst in the engine-rooms of steamships a high degree of turbulence in ventilation was required, the same conditions did not apply with a Diesel engined ship.

Dr. Blache promised to give a detailed reply in writing to the various questions raised.

(To be continued.)

WORKING MEN'S TOURS TO CONTINENTAL INDUSTRIAL CENTRES.—Four workers in electricity and engineering are among the twenty successful candidates in a prize essay competition organised by the Economic League in conjunction with five prominent business firms to provide British workmen with an opportunity of studying industrial conditions on the Continent at first hand. They are:—Mr. John Thomas Hammond, of Leyton, an employee of the London Electric Wire Company and Smiths, Ltd.; Mr. James Maxwell, of Glasgow, an engineering tool turner in the employ of Messrs. Wm. Simons and Co., Renfrew; Mr. John Victor Shaw, of Catford, an electrical engineer in the employ of Elliott Bros. (London), Ltd.; Mr. John Brown, of Darlington, a draughtsman in the mechanical engineering department of Synthetic Ammonia and Nitrates, Ltd. There were 548 competitors, representative of twenty different industries. The four workers enumerated above will join the other successful candidates on Sunday, April 19th, in London. After visiting a number of the leading London establishments, including those of the Auto-Strop Safety Razor Company, Ltd.—now Gillette Industries—Benn Bros., Ltd., Hovis Ltd., and Crosse and Blackwell, Ltd., who are bearing the entire cost of the tour, the party will leave by the night boat on Tuesday, April 22nd, for Antwerp. Subsequently they will visit workshops, factories and industrial training schools in Antwerp, Liége, Düsseldorf, Essen, Cologne, and Lille, arriving back in London on Wednesday, April 29th.

Two Railway Dry Docks at Quebec.

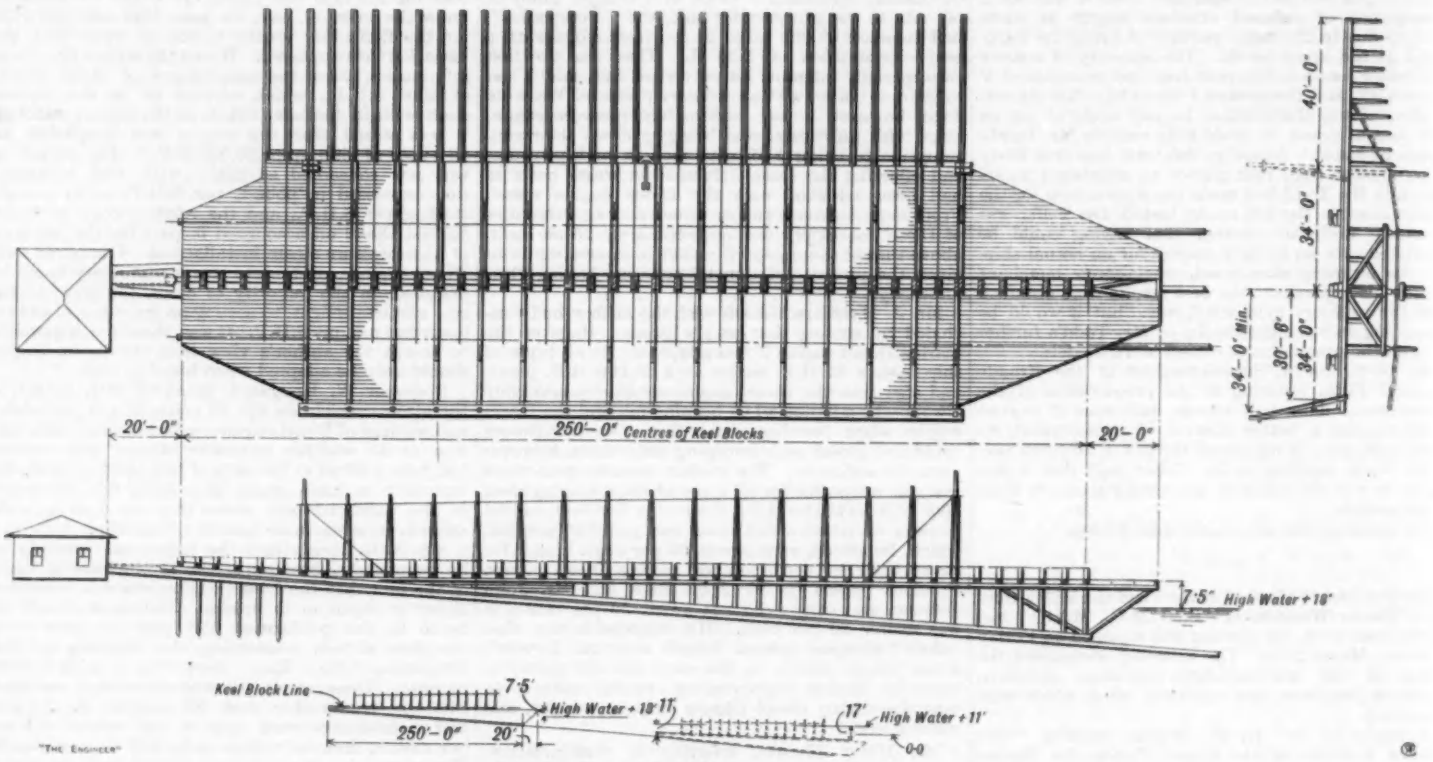
THE City of Quebec has, for many years past, been making continuous improvements in piers and port facilities to accommodate modern vessels and meet their needs. These facilities include two graving docks across the St. Lawrence in Lauzon for vessels up to 1150ft. long. Until recently, however, there were no means particularly adapted for dry docking harbour craft and other vessels up to the Welland Canal size, and the use of the Government-operated graving docks was found costly. Quebec interests began to recognise the need for smaller dry docks suited for such vessels, George T. Davie and Sons and the Morton Engineering and Dry Dock Company taking a very active part. After lengthy consideration each of these concerns decided to construct a railway dry dock of 1800 long tons capacity and of dimensions adapted for Welland Canal type vessels.

The conditions obtaining at Quebec are rather unusual. The water is fresh with a wide tidal range. High tide varies from about +18·0 to +11·0. Navigation closes on the St. Lawrence about November 20th, and the river is ice-bound usually until after April 15th. During the winter the shore ice, locally called "baturo ice," builds up 15ft. to 20ft. thick, which breaks up in the spring and floats down stream, much of it grounding at low tide on the shore or submerged structures. It was therefore essential to obtain adequate depth over the keel blocks of the docks during extreme neap high tides, and at the same time to have the cradle substantially clear, when hauled up, at extreme high tides, so as to avoid ice damage to it during the winter and spring.

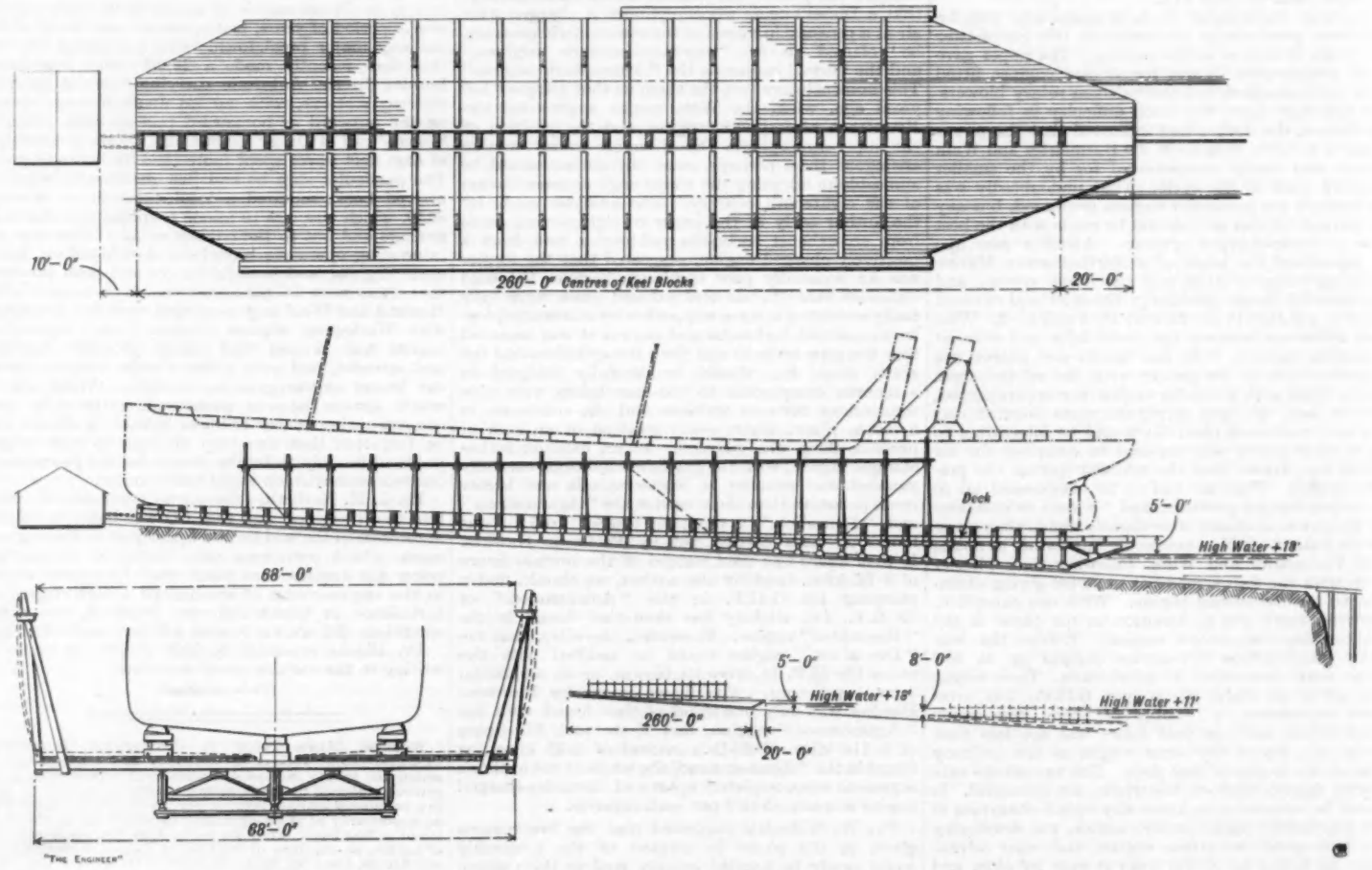
The site chosen for the railway dry dock of the Morton Engineering and Dry Dock Company is on the Quebec shore at the mouth of the St. Charles River, just above the piers, the land being leased by the Quebec Harbour Commission. The length available was limited by the channel on one side and the railway right of way on the other. The top soil was sand fill overlying a natural sand deposit.

The site for the dock of George T. Davie and Sons is on the south bank of the St. Lawrence at Lauzon, opposite Quebec, just above the graving docks. Ample space was available both inshore and outshore. Borings showed that, down to half tide, the ground consisted of a thin layer of broken shale fill—being the *débris* from the graving dock excavation—overlying the original shale rock. At half-tide level there was a vertical fault beyond which borings to a depth of 30ft. indicated only sand with a thin top layer of compact gravel.

The tracks for both installations are of the three-way type, with a heavy centre track and lighter side tracks. Those for the Morton dock are constructed of select



THE MORTON ENGINEERING COMPANY'S DRY DOCK



DAVIE AND SONS' DRY DOCK

Douglas fir, supported on a foundation of local pine and spruce piling. In order to meet the exigencies of the site, these tracks, 672ft. in length, were laid down on a vertical arc of a circle of which the chord has a slope of 1 to 13·2. Above water the exposed wood surfaces and the heads of the piling were coated with creosote to prevent decay.

The tracks for the Davie dock are constructed of reinforced concrete for the upper 362ft., placed directly on the rock surface, the outer portion being constructed of select Douglas fir supported on a foundation of wood piling driven to adequate safe bearing in sand. They are 770ft. long, laid

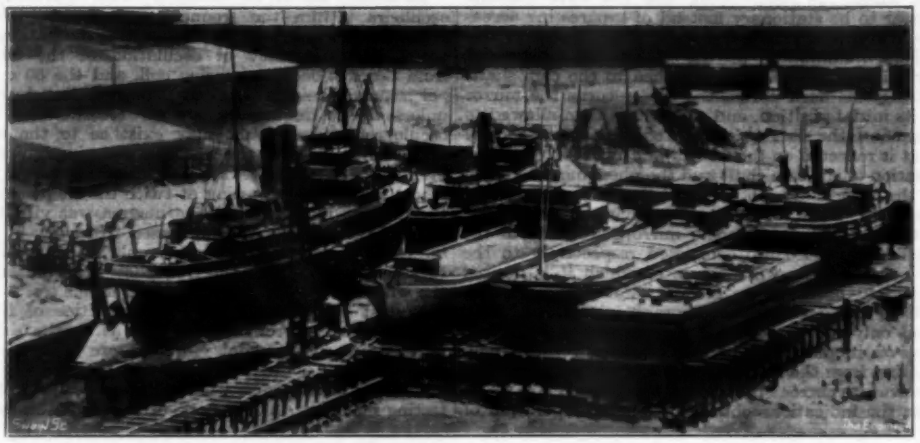
down on a vertical arc, of which the slope of the chord is 1 to 17.

The cradle of the Morton dock, 250ft. long over the keel blocks and 68ft. wide, is constructed of Douglas fir, the principal members being of structural grade. In its outer position the depth of water over the keel blocks is 11ft. forward and 17ft. aft at high water of neap tides, and in its uppermost position the line of keel blocks is horizontal, being 11ft. above high water of spring tides. It is decked over its full width for a length of 270ft. to provide a working platform, including an extension of 20ft. at the after end to facilitate repairs to wheels and rudders. There are sixteen sliding bilge blocks on each side of the cradle, operated by galvanised chains and hand winches situated on the docking platform.

The cradle of the Davie dock is 260ft. long over the keel blocks and 68ft. wide. The underframe of the cradle is constructed of structural steel, the cross beams and superstructure being of Douglas fir. It is decked over its full width for a length of 280ft., including a fantail 20ft. long at the after end. On each side of the cradle there are fifteen sliding bilge blocks operated by galvanised chains and hand winches situated on the docking platform. In its outer position the depth of water over the keel blocks is 8ft. forward and 17ft. aft at high water of neap tides, and in its upper position the keel blocks aft are 7ft. above high water of spring tides.

In both these railway dry docks the cradles move over the tracks on free flanged rollers between flat steel rail plates fastened to the top of the tracks and to the bottom of the cradle runners. The rollers are arranged in interchangeable frames 15ft. long. The use of these rollers, instead of truck wheels, eliminates the necessity of lubricating hundreds of journals and reduces the friction to that of a roller bearing.

Owing to the long season of closed navigation during the winter months it is of advantage to have several vessels hauled out for repairs during that time. For that reason



THE MORTON COMPANY'S YARD—WINTER 1929-30

both cradles were designed for cross transfer cars so that vessels could be dry docked and pulled to one side in the yard. On the Morton railway dry dock the docking platform is omitted on one side of the cradle and the cradle equipped with transverse railway rails and steel transfer cars for vessels weighing up to 1000 tons. During the autumn of 1929 eight vessels were hauled out and stored for repairs during the winter. On the Davie dock the docking platform is omitted for half the length of one side and the cradle is equipped for the transfer and storage of vessels weighing up to 600 tons.

Each of these railway dry docks is hauled by two heat-treated manganese cast steel chains, without welds, connected to the cradle through an equalising mechanism. To the free end of each hauling chain there is attached a smaller wrought iron backing chain which passes through an underwater sheave. The other ends of the two backing chains are then attached to the cradle through a backing chain equaliser, the chains thus being arranged in an endless system. The principal function of the backing chain is to pull down the free part of the hauling chain. Means of tightening the backing chains is provided, so that the whole system may be kept in a proper state of tautness.

The hauling chains pass around chain wheels keyed to the main shafts of the hauling machines. Each of these machines is made up of a train of machine-moulded gears of semi-steel and operated by a double link motion steam engine of sufficient power to dry dock a capacity vessel in about thirty minutes. There are two speed ratios, obtained by sliding gears, the slower one for capacity loads and the faster one for dry docking smaller craft.

Both of these dry docks were designed and constructed by the Crandall Engineering Company, of Boston, Massachusetts, U.S.A. They were completed in about eight months after the construction was started. Views of the two docks are given on page 406.

Concentration in the German Locomotive Industry.

A FURTHER step in connection with the consolidation of the German locomotive industry has taken place in recent months. It appears that the builders have again followed the advice of the Reich railway authorities, who had informed them that owing to the inconsiderable number of locomotives which would be needed in the next few years, the builders must help themselves by the elimination of various works which were held to be superfluous, if they wished to improve the position of the industry. The concentration movement is to be continued with the further support, as far as it can possibly be given, of the Reich railway authorities.

In former times under the activity of the inland locomotive syndicate, each works was allotted a quota of new construction in meeting the requirements of the railways, but as the needs of the latter are now comparatively inconsiderable, the railway authorities a few months ago decided to restrict their future orders to a limited number of works. In this way certain works would be excluded from any further participation in the orders. In particular, this would have affected the Berlin Allgemeine Elektrizitats Gesellschaft, which turns out both steam and electric locomotives at its works at Hennigsdorf. Such an exclusion would have implied, it was considered, a prejudice to the company's export trade in steam locomotives, and also have increased the costs of the construction of the mechanical parts of electric locomotives at the same works. Under the circumstances, the A.E.G. entered into negotiations with the A. Borsig G.m.b.H., of Tegel, Berlin, with a view to the introduction of a system of co-operation between the two companies in the construction of steam locomotives. The negotiations led to the formation of a joint producing company, under the title of the Borsig Lokomotive Werke G.m.b.H., of Berlin, which has taken over a lease of the steam locomotive departments of the two companies. The A.E.G. is interested in the new company to the extent of 60 per cent. and the Borsig company to 40 per cent. The large share of the former company is due to the A.E.G. having granted a loan of 7,000,000 marks for the acquisition by the new company of the Borsig Company's quota in the Reich railway orders. It is stated that the expenditure on the acquisition of the Borsig quota is less than what would have been necessary for the A.E.G. to have incurred on writings down and losses if its steam locomotive department had had to be entirely shut down.

In connection with the amalgamation of the steam locomotive departments of the A.E.G. and Borsig, mention was made at the time of the possible inclusion in the new company of the Berliner A.G. vorm. L. Schwartzkopff. But, according to the proceedings at the recent meeting of this company, it intends to continue to act independently despite the fact that the works will only have a moderate amount of work from the Reich railways in the next three years, as represented by twelve locomotives per annum. This number will naturally only cover the minimum requirements of the company for the period in question, but the principal value of the order is considered to lie in the circumstance that it will ensure continued connection with the Reich railways and have the result of the establishment of an export syndicate, and possibly, as was said, of international arrangements at a later date.

A further movement is noted in the announcement that the Hannoversche Maschinenbau A.G. has entered into an agreement with Henschel und Sohn A.G., of Cassel, under which the former has undertaken to discontinue the construction of locomotives and has transferred its quota in the Reich railway orders to the Cassel company. In return for the assignment of the quota, the Cassel company agreed to pay the sum of 5,000,000 marks to the Hanover company. A still further step has been taken by the decision of the J. A. Maffei A.G. to give up its manufacturing business in favour of the locomotive works of Krauss and Co., of Munich. Under the amalgamation the undertaking has assumed the title of the Lokomotivefabrik Krauss and Co.-J. A. Maffei A.G., and the absorbing company is paying 2,000,000 marks for the Maffei machinery and stock.

The contracts between the Reich railway and the locomotive industry concern 270 units, which are to be delivered over a period of three years. Of the ninety locomotives to be supplied in the first year, it is understood that thirty-four will be delivered by the Henschel Company, of which fourteen represent the quota of the before-mentioned Hanover company; eighteen will be delivered by the F. Krupp Company; fourteen by the A.E.G.-Borsig Company; and twelve each by the Schwartzkopff Company and the Schichau Company, the latter being a State-subsidised concern. Apart from these contracts, a single and final order for five locomotives has been or is to be given to the Orenstein and Koppel Company, while the Bavarian works of Krauss-Maffei will supply ten and the Wurtemberg works of the Esslinger Maschinenfabrik two. These latter contracts are on the basis of the arrangements existing between the Reich railway and the States of Bavaria and Wurtemberg.

Apparently the Reich railway authorities have imposed certain conditions on the above-named four principal builders in regard to the rationalisation of the types of locomotives and community of working. Moreover, these firms have undertaken to form a locomotive export syndicate which, according to the time fixed for its constitution, should by now have already been brought into activity. In the meantime, it is noted that a Dutch order for the delivery of twelve locomotives to the Netherlands Railways was placed a few weeks ago with the Berlin Schwartzkopff company at the price of 65,450 florins per unit. A Dutch works—the Werkspoor company—tendered at the price of 76,000 florins, while the Krupp company asked 70,200 florins, and the Henschel company 66,700 florins. It appears that before a decision was reached the Dutch State Commission on relieving unemployment intervened and proposed that a subsidy should be granted to the Werkspoor company to enable it to accept the order at 65,000 florins per locomotive. But the Dutch works assumed the standpoint that the German offer was a case of dumping, and stated, it is reported, that it was beneath the dignity of a great undertaking to accept a State subsidy and sell at a cut price.

B.E.S.A. Specifications.

VALVE FITTINGS FOR COMPRESSED GAS CYLINDERS.

The British Engineering Standards Association has just issued a British Standard Specification for Valve Fittings for Compressed Gas Cylinders. This specification provides for valve fittings for compressed gas cylinders for practically all the gases in general use and requirements are included for a safety release for carbon dioxide cylinders. In an appendix particulars are given of inspection gauges for checking the threads on the valves and the threads in the cylinder necks. The National Physical Laboratory is the custodian of the standard gauges, so that the working gauges necessary for the production of cylinders and valves can be checked at a reasonable cost.

IDENTIFICATION COLOURS FOR GAS CYLINDERS.

The Association has also just issued a British Standard Specification for Identification Colours for Gas Cylinders. This specification provides for identification colours for gas cylinders for gases most commonly in use, the underlying principle of the scheme being that yellow should represent toxic or poisonous gases, and red, or maroon, inflammable gases. For example, hydrogen and coal gas cylinders are to be coloured red, whilst chlorine cylinders are to be coloured yellow, whilst the colour of cylinders for carbon monoxide—an inflammable and a very poisonous gas—is a yellow ground with a red band. The Committee responsible for the preparation of the schedule has recognised that there are other gases used in limited quantities for which a colour has not yet been allocated, and it points out that it is important that the colours so far adopted should not be used for gases other than those indicated.

TAR FOR ROAD PURPOSES.

THE British Engineering Standards Association has just published a further specification for road tar, designated "Tar No. 3." This specification, the draft of which was prepared by the British Road Tar Association, provides for a tar suitable for the manufacture of tarmacadam laid by the hot or semi-hot process, as an alternative to Tar No. 2, contained in B.S. Specification No. 76—1930, and its viscosity is higher than that of this latter tar. The methods of testing and specifications for apparatus which are given as appendices have been prepared by the Standardisation of Tar Products Tests Committee and are based on this Committee's publication "Standard Methods for Testing Tar and its Products."

PHOSPHOR BRONZE AND NAVAL BRASS PLATES, SHEETS, AND STRIP.

Two further British standard specifications for non-ferrous sheets and strips have recently been issued by the British Engineering Standards Association. They are No. 407, Phosphor Bronze Sheets and Strip, excluding drawn material; and No. 409, Naval Brass Plates, Sheets, and Strip, excluding naval brass condenser plates. The first specification covers two alloys, high tin and low tin respectively, each in five tempers, the tensile strength ranging from 18 to 43 tons per square inch. The second specification provides for both hot-rolled and cold-rolled material of tensile strengths from 22 to 26 tons per square inch Both specifications call for tensile and bend tests, whilst a forging test is also stipulated in the case of the naval brass. The chemical compositions and the tolerances to be permitted on the dimensions of the sheets are specified, and clauses relating to the provision of test pieces and testing facilities are included.

AIRSCREW HUBS AND THEIR FIXINGS.

The British Engineering Standards Association has recently issued a revision of the B.S. Specification No. 87, Airscrew Hubs. The new specification is divided into two parts. Part 1 deals only with the fixing of the airscrew to the airscrew hub. Part 2 contains the recommendations for the standard engine flange fixings for airscrew hubs to meet the rapid development of detachable bladed airscrews, metal airscrews, metal airscrews and gear-box transmission to multiple airscrew machines. It is recognised that airscrews are not required to be interchangeable between existing types of aircraft engines, and that each new design of engine has its own particular type of hub, but, at the same time, it is felt that there is a need for information as to the basis for the design of these fittings. Whilst a considerable amount of experience in service must be obtained before any dimensions can be finally accepted as British Standards, it is hoped that this issue of the specification will assist the development of new designs of engine shafts and airscrews towards a standard method of attachment.

Copies of any of the above specifications may be obtained from the British Engineering Standards Association, Publications Department, 28, Victoria-street, London, S.W. 1, price 2s. 2d. each post free.

Axial Vibration of Rotating Steam Turbine Disc Wheels.

R. H. COLLINGHAM, M. Inst. C.E., M.I. Mech. E.

No. II. (*Conclusion*).*

THE electrical connections of the various exploring coils, the electrical circuits of the amplifiers used, and of the oscillograph and of the exciting magnet used in tests are shown diagrammatically in Fig. 4. The

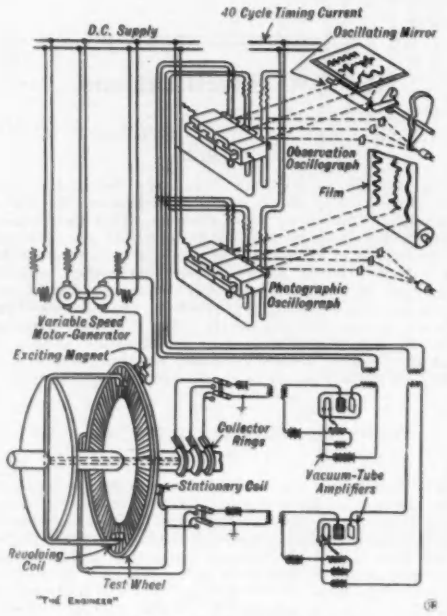


FIG. 4—ELECTRICAL CONNECTIONS

connections from the rotating coils lead out through the shaft and are connected with slip rings, the brushes from which lead to the primary of a transformer, a suitable source of D.C. being connected in series.

The stationary coil is connected through a switch to the primary of another transformer. The secondary windings from these transformers are connected respectively to suitable amplifier devices for magnifying the current fluctuation produced through the action of the test wheel on the exploring coils.

It will be understood that the current in one of these exploring coils, coming from the battery, develops a magnetic field, the magnitude of which varies in accordance with the variation in the air gap between the adjacent parts of the wheel and the magnetic coil. In the case of the rotating coil, the lateral vibration of the adjacent part of the wheel produces a change in magnetic reluctance. In the case of the stationary coil, the change in magnetic reluctance is produced by variations in the distance of the wheel rim as it sweeps past the stationary coil. These variations in distance are due, partly to irregularities in the structure of the wheel itself, and, in case of wave phenomena, to lateral deflections of the wheel. The current induced in the transformer secondary windings is amplified by thermionic valves. The amplified fluctuating current is then led through another transformer, the secondaries of which lead to the oscillograph vibrators. The oscillographs, indicated diagrammatically in the upper portion of Fig. 4, are standard instruments for producing and for recording images representing the fluctuations from instant to instant of electric currents. These images may be produced by the trace of a point of light upon a ground glass or in a mirror, or images may be recorded permanently on a photographic film.

The fluctuating current is led to the bifilar suspension armature, which carries a small mirror. The armature, which is arranged in a strong magnetic field, oscillates in proportion to the fluctuations in the current. Light from an arc lamp is transmitted through a lens and prisms to the mirror, and is reflected in turn to a suitable receiving surface. As used at present, this consists of an oscillating mirror, which is arranged to oscillate about a horizontal axis. The frequency of these oscillations is directly proportional to the speed of rotation of the test wheel. When this mirror is oscillated the wave forms are rendered visible by reflection on a ground glass receiving screen. The pivoted mirror is caused to oscillate by means of an arm, which is held by a spring in contact with a cam. This cam is driven by a synchronous motor connected with the cam shaft. The synchronous motor receives the current from the small alternator I, Fig. 3, *ante*, driven directly by the shaft carrying the test wheel, the result being that the wave motions appear to be stationary instead of progressing across the field of vision.

The illumination of the screen is interrupted periodically by a shutter attached to the cam shaft. During this dark period the cam returns the mirror to its initial position, and the light is then allowed to illuminate the screen again. Actually, only a spot of light is reflected on the screen, but owing to the rapid rotation of the cam shaft and the phenomenon known as the "persistence of vision," the spot appears as a complete, more or less wavy line. Three bifilar circuits carrying oscillating mirrors are used in the oscillograph, and are connected respectively to the coil circuits, the wave forms of which it is desired either to observe or record. For reasons which will be explained, the oscillograph just referred to is used only for purposes of observation. One circuit receives its current indirectly from the rotating coil, another from the stationary coil, and the third circuit receives its current from a source of 50-cycle A.C., so that the indications obtained from the operation of this latter member of the oscillograph serve as a time standard for the waves produced by the other two circuits.

A similar oscillograph, provided for the taking of photograph films, has all its circuits connected in multiple with those of the observation oscillograph just described, so that both receive currents of the same character. Inasmuch as the wave phenomena in the turbine wheel are transitory, the presence or absence of these wave phenomena is observed by inspection of the reflections from the oscillating mirror. When, however, the operator observes in the mirror of the observation oscillograph the occurrence of any particular wave phenomenon, which it is desired to record, he operates the shutter of the recording oscillograph, thus causing an exposure to be made upon the film, which is immediately developed in the usual manner.

As before stated, a magnet which can be energised with A.C. or D.C. is provided in the fabricated steel casing. This magnet is used when energised with A.C. to cause the turbine wheel disc to vibrate when stationary, the frequency of the A.C. supply being capable of variation. Thus, standing vibrations at the varying frequencies for four, six, eight, ten, &c., nodes or two, three, four, and five, &c., nodal diameters, can be induced in the wheel and the wave photographed by the oscillograph simultaneously with the impressed frequency on the A.C. magnet and against the 50-cycle timing wave. A record of all these three observations is important for the standing frequencies at various numbers of nodes.

Fig. 5 shows the shaft with the rotating coil wheel and the bladed turbine wheel disc in the bottom half of the fabricated steel case. This figure shows clearly the supports for the rotating coils spaced 180 deg. apart. Fig. 6 shows the shaft with the rotating coil wheel and the bladed turbine wheel disc wheel in the dynamic balancing machine in order to ensure as perfect a balance as possible before running in the wheel testing machine.

Fig. 7 gives a reproduction of the oscillograph record of a wheel tested in the wheel-testing machine when rotating at various required speeds. The stationary frequency tests are first taken for various numbers of nodes, four, six, eight, &c., or number of nodal diameters, two, three, four, &c.

As already stated, the stationary tests record on the oscillograph film the frequency of the impressed voltage on the magnet used for vibrating the stationary wheel, the frequency of oscillation of the wheel from the stationary exploring coil, and the 50 cycle per second timing wave. It has been found that, unless these frequencies are all recorded on the oscillograph film, doubt may exist as to the true natural frequency of the wheel at any given number of nodes. Cases have been recorded in which the wheel, instead of vibrating at twice the frequency of the current in the alternating magnet was vibrating at some multiple of the impressed frequency of the alternating magnet. Therefore, unless care is taken to ascertain definitely the frequency of vibration of the wheel disc when stationary, and if this test is the only test carried out—as is the practice of some manufacturers—wrong conclusions as to the safety of the discs from nodal vibration are likely to be drawn. Fig. 7 shows a typical oscillograph record for a rotating turbine disc wheel in the wheel vibration testing machine. A four-node or two-nodal diameter wave train is very clearly developed in it. As the wave travels past the rotating coil the adjacent portion of the wheel oscillates backward and forwards, so as to produce the wave record marked "rotating coil." It will be seen that in the space marked one revolution as indicated, there occur two wave crests on each side of the zero line of the wave shape. Since there are two wave crests on each side of the wheel, making a total of four, this record indicates the presence of a four-node wave train or one of two-nodal diameters. The stationary coil shows a series of waves which on examination will be found to be just twice

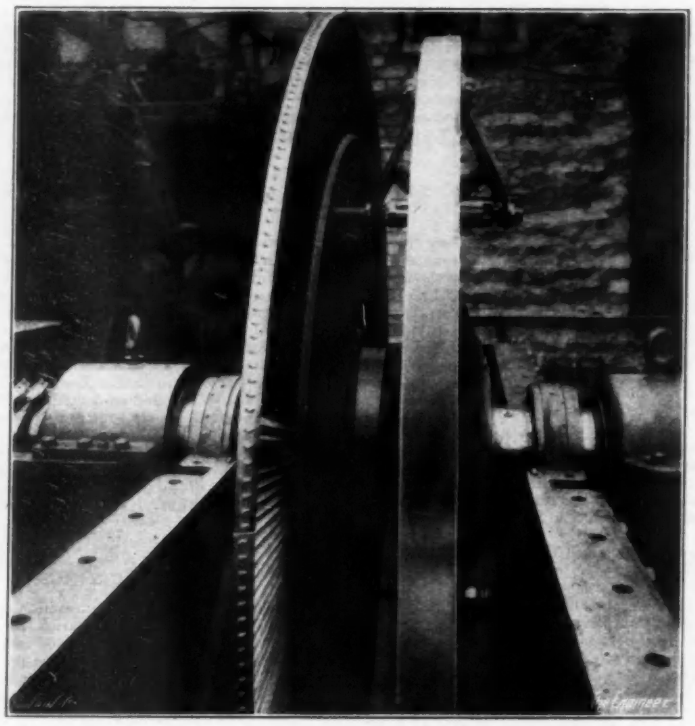


FIG. 5—WHEELS AND COILS IN VIBRATION TESTING MACHINE

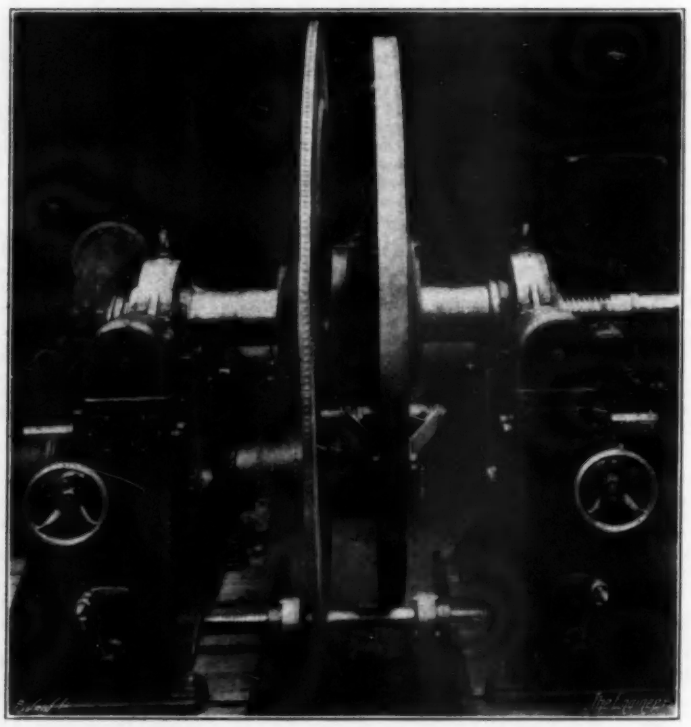


FIG. 6—WHEELS AND COILS IN DYNAMIC BALANCING MACHINE

* No. I. appeared April 3rd.

as many in number as those appearing in the rotating coil record.

The double frequency wave shown by the stationary search coil represents a wave travelling forward in the wheel. The fact that the frequency shown on the curve for the stationary search coils is exactly twice the frequency of the rotating coil, confirms the fact that we are here dealing with a critical speed phenomenon in which the backward travelling wave coil, because this wave train is carried forwards by the wheel, and is thus passing the fixed coil at a higher speed than it would were the wheel not rotating. This rise in frequency is measured by the number of wave lengths per second that the wave train is carried forward by the wheel rotation which equals the product of the number of waves on the wheel rim $\frac{1}{2}n$ by the number of revolutions per second of the wheel N_s. This product $\frac{1}{2}n\,N_s$ is the frequency in excess of that

FIG. 7—OSCILLOGRAPH RECORD

is stationary in space and has a forward wave superposed upon it. The interpretation therefore of the record, Fig. 7, is as follows:—Four-node or two-nodal diameter critical speed; frequency, 42·7 cycles per second; revolutions per second of wheel, 21·20.

During a complete test on a turbine disc wheel, a series of records similar to Fig. 7 are taken for four, six, eight, &c., nodes, or two, three, four, &c., nodal diameters. The critical speeds at which these wave trains will occur can be predicted closely from the stationary frequency records.

In addition to critical nodal speeds which, as has already been explained, are the speeds for any given number of nodes or nodal diameters in which the backward travelling wave is stationary in space, other nodal resonant speeds occur which are termed "minor resonant" speeds. In these cases the backward running wave train is not travelling backwards as fast as the wheel disc is running forward, and therefore we can get records from the oscillograph of minor resonant speeds in which the backward running wave will record through the stationary search coil a frequency of one cycle per revolution, the rotating coil will show a frequency of three cycles per revolution, and the forward running wave train, if present, would indicate through the stationary search coil a frequency of 55 cycles per revolution. Such a record we should term a four-node first minor resonant speed. Similarly we can have a four-node second minor resonant speed where the frequencies recorded on the film per revolution would be either two or six cycles on the stationary search coil and four cycles on the rotating search coil.

Similarly minor resonant speeds occur for two, four, six, eight, &c., nodes, or one, two, three, four, &c., nodal diameters. As these minor resonant speeds cannot build up to dangerous magnitudes as compared with "critical nodal speeds," they are from the point of view of failures of the turbine wheel discs not so important. Nevertheless it is desirable, wherever possible, to safeguard the wheel discs by tuning from these minor resonant speeds in the neighbourhood of the normal running speed of the unit because of the liability to produce fatigue in the wheel disc.

When a complete set of oscillograph records for stationary and running conditions has been obtained, it is analysed and used to calculate frequency of vibration, number of nodes or nodal diameters, and revolutions per second of the wheel testing machine at which the films were taken.

The facts are shown graphically in Fig. 8, which gives a diagrammatic representation that has been found to be very useful. This diagram was devised by Mr. W. Campbell, of the General Electric Company, of America. The vertical scale represents the frequency registered in an oscillograph by the magnet coils, and the horizontal scale the rotational speed of the disc. The middle curve gives the variation of frequency with speed as recorded by the revolving coil. The upper and lower curves show the two frequencies registered by the fixed coil, the upper giving the frequency due to the forward component wave, and the lower the frequency due to the backward component wave train of the nodal vibration. For instance, consider the four-node vibration. When the wheel is at rest the figure shows that both coils register 30. As the speed of the wheel is raised to 21·2 r.p.s. the revolving coil frequency rises to 42·7 and the two frequencies recorded by the fixed coil diverge. The gradual rise of frequency of the wheel as its speed is increased is expressed by the equation previously given, viz.,

$$f_r = \sqrt{f_s^2 + B\,N_s^3}.$$

The upper curve shows how the frequency of a forward-moving wave train, as measured at a fixed point, rises relatively to the frequency detected by the revolving of the wheel as measured by the revolving coil; that is, in excess of f_r. If H is the higher frequency recorded by the stationary coil and represented by the upper curve, then

$$H = f_r + \tfrac{1}{2}\,n\,N_s.$$

In the same way the lower curve shows how the frequency of the backward travelling wave as measured at a fixed point is decreased because in

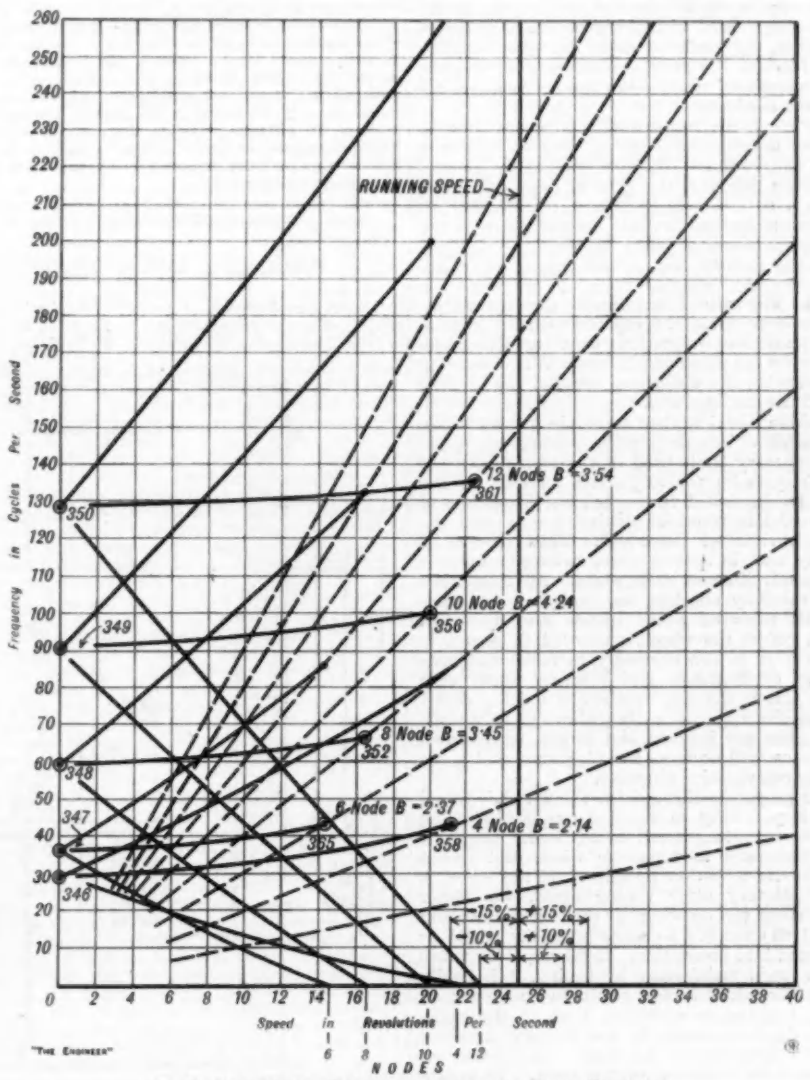


FIG. 8—GRAPHICAL REPRESENTATION OF TEST RESULTS

case the wave motion is opposite in direction to the motion of the wheel. Thus if M is the lower frequency recorded by the stationary coil and represented by the lower curve,

$$M = f_r - \tfrac{1}{2}\,n\,N_s.$$

If the backward moving component wave train is absent, only the upper frequency is registered by the fixed coil corresponding to a forward moving travelling wave. If the forward moving component wave train is absent, only the lower frequency is recorded, due to the backward travelling wave. The frequency recorded by the revolving coil, however, is always the same whether one or both of the component wave trains exist and in whatever relative amplitudes they exist. It is therefore evident that by the use of two exploring coils as described, one revolving with the wheel, the other being fixed in space, the presence of a forward or a backward travelling wave train or both can be detected. Furthermore, at the wheel speed of 21·2 revolutions per second the backward wave train component cuts the zero frequency line, thus showing that the nodal vibration is critical and stationary in space and the stationary coil records the high-speed forward running wave component of 85·4 cycles per second. The speed coefficient B of the turbine wheel disc under consideration gives a calculated value from the oscillograph records for four-node, *i.e.*, two-nodal diameters of 2·14

For six nodes or three nodal diameters B = 2·37.
For eight nodes or four nodal diameters B = 3·45.
For ten nodes or five nodal diameters B = 4·24.
For twelve nodes or six nodal diameters B = 3·54.

With the help of the data obtained on turbine disc wheels actually tested in the wheel vibration testing machine it is possible to proceed with certainty in developing wheels for turbines of increasingly large output, and to assure their satisfactory operation in commercial service.

An outline of the procedure followed in developing the design of new turbine disc wheels may be of interest. The first step in designing a bucket wheel is to determine the general design of the bucket, establish the dovetail required for the bucket and use the centrifugal force of the bucket to determine the general contour of the rim of the wheel. This is necessary so as to make a careful re-check when the whole design is established, to see that the tangential bucket vibration and the lateral wheel vibration are satisfactory. The determination of the thickness of hub, web and rim to avoid lateral vibration is accomplished by comparison with accumulated data on other wheels and a careful study of the actual data obtained on running wheels as to frequencies and their behaviour under running conditions.

The wheel is then laid out to scale. The thickness at several points is determined to insure uniformity in shape. It is necessary to carry out this very carefully, as all our lateral wheel vibration data are based on definite curves for the shape and design of wheels used. Stress calculations made from full-size layout

BRITISH RAILWAY RESULTS IN 1930

TABLE I.—*Receipts and Expenditure.*

	London, Midland and Scottish.		London and North-Eastern.		Great Western.		Southern.		Four grouped companies.	
	1930.	1929.	1930.	1929.	1930.	1929.	1930.	1929.	1930.	1929.
Receipts :	£	£	£	£	£	£	£	£	£	£
From railway working, passenger	27,217,194	28,722,807	18,368,343	19,097,093	12,350,015	12,781,195	16,563,623	16,969,015	74,499,175	77,570,110
From railway working, freight	40,368,765	43,816,074	33,584,082	35,985,016	16,979,507	17,976,977	5,575,683	5,742,581	96,508,037	103,520,648
From railway working, miscellaneous	655,465	656,383	438,283	478,985	260,395	270,303	256,620	280,913	1,610,763	1,686,584
From railway working, total	68,241,425	73,195,264	52,390,710	55,561,094	29,589,917	31,028,475	22,395,927	22,992,509	172,617,979	182,777,342
From other businesses	8,203,676	8,465,784	7,434,698	7,734,361	4,756,950	5,155,578	3,494,213	3,514,509	23,889,537	24,870,232
On whole undertaking, total	76,445,101	81,661,048	59,825,408	63,295,455	34,346,867	36,184,053	25,890,140	26,507,018	196,507,516	207,647,574
Expenditure :										
On railway working, way and works	7,192,009	7,675,107	5,565,784	6,015,405	3,646,563	4,046,379	3,419,955	3,473,733	19,824,311	21,210,624
On railway working, rolling stock	9,881,817	10,288,804	8,343,953	8,938,504	3,975,305	4,116,180	2,777,412	2,916,606	24,978,487	26,260,094
On railway working, locomotive running	13,647,433	14,078,362	10,293,901	10,418,666	5,459,549	5,522,955	4,193,322	4,203,305	33,594,205	34,223,288
On railway working, traffic	20,261,589	20,807,298	14,513,928	14,653,196	8,086,557	8,144,060	5,678,949	5,691,270	48,541,023	49,295,824
On railway working, general	5,090,981	5,304,994	3,145,495	3,256,870	2,449,238	2,478,967	1,858,713	1,889,593	12,544,427	12,930,424
On railway working, total	56,073,830	58,154,565	41,863,042	43,282,641	23,617,213	24,308,541	17,928,351	18,174,507	139,482,436	143,920,254
On other businesses	8,394,562	8,752,097	7,343,057	7,612,872	4,609,264	4,900,250	2,773,368	2,739,742	23,120,251	24,004,961
On whole undertaking, total	64,468,392	66,906,662	49,206,099	50,895,513	28,226,477	29,208,791	20,701,719	20,914,249	162,602,687	167,925,215

TABLE II.—*Details of Main Items of Engineering Expenditure.*

Way and works :										
Roads, bridges, and works	931,439	952,061	754,210	790,062	573,223	816,035	489,986	517,777	2,748,858	3,075,935
Permanent way	4,567,767	4,589,475	3,177,154	3,364,343	2,140,051	2,178,328	1,815,832	1,936,603	11,700,804	12,068,749
Signalling	585,350	633,716	567,406	570,457	317,881	322,157	294,068	350,676	1,764,705	1,877,006
Telegraphs and telephones	202,505	193,918	129,160	140,877	85,827	95,521	89,916	83,389	507,408	513,705
Electric track equipment	24,867	30,165	10,341	13,773	4,214	1,412	67,609	201,271	107,031	246,662
Buildings	1,014,896	1,178,102	741,952	750,077	583,916	534,958	533,376	630,650	2,874,140	3,093,787
Rolling stock :										
Locomotives	4,803,775	4,914,463	3,726,304	3,981,856	2,402,172	2,456,583	994,423	1,028,033	11,926,674	12,380,935
Electric rail motor vehicles	153,794	184,483	28,136	25,942	3,123	6,603	351,172	466,026	536,225	683,054
Coaching stock other than above	2,838,043	2,860,129	1,997,774	2,247,114	1,083,787	1,057,416	1,074,504	951,041	6,994,108	7,115,700
Wagons	2,796,645	2,896,441	2,485,809	2,563,213	901,831	651,945	465,133	364,587	6,649,418	6,476,181
Locomotive running :										
Wages, steam trains	7,865,571	8,081,058	6,444,941	6,470,745	3,516,621	3,531,811	1,890,542	1,892,709	19,717,675	19,976,323
Fuel, steam trains	4,683,007	4,808,669	3,527,032	3,624,686	1,725,665	1,760,440	1,339,483	1,367,749	11,275,187	11,561,544
Wages, electric trains	80,696	81,529	16,901	16,811	4,025	3,888	170,040	155,440	271,662	257,668
Current, electric trains	359,359	340,381	45,635	43,204	37,987	37,251	571,433	566,954	1,014,414	987,790

and curve sheets plotted. If stresses are not below the established standards, it is necessary to lay out a new design. Whether carbon steel or alloy steel is to be used for the wheel is determined by the stresses and temperatures. The positions of the steam balance holes are very carefully checked and copied in the wheel, to keep them within the established limits. At this time, the draw-off holes are also carefully considered as are the grooves for balancing weights, which happen to be either in the first or the last stage wheel of the machine.

At this point, the wheel design is turned over to the turbine drawing-office to be used in making a layout of the machine. If, after making the general layout of the machine, the general design is found satisfactory, details are made and turned over to the calculating section for final comparison with the original layout, material called for, &c.

Should the factory, during the process of manufacture, make any departure from the drawing, it is reported to the turbine engineering department by the factory inspector, and compared with the original layout, stress and vibration data to determine whether or not the wheel can be used. A new drawing is made showing the difference between the original design and the modified one.

The turbine wheel is then tested in the vibration testing machine. The standing frequencies are taken on the temporary shaft used in the tests; also the running frequencies for all nodes as well as the vibration tendencies of the wheel, the broadness of resonance of the wheel at critical points and the general behaviour of the wheel. This requires at least thirty and, in special cases, twice this number of oscillograph films on each wheel. All these films are very carefully checked and analysed and compared with films of other wheels and those in operation, before the wheel is allowed to pass into production. It is also necessary to make diagrams from these oscillographs and compare them with others, as this is the only method of quickly determining the discrepancies in the behaviour of wheels. All these films are indexed and certain data drawn from them as well as from the diagrams, which are indexed for comparative purposes.

If, after preparing these data, the wheel is found unsatisfactory, owing to running frequencies being close to the operating speed or any other causes, it is again necessary to tune the wheel and repeat the test in the vibration machine. If the wheel is found satisfactory after tuning again, we either have to change the drawings or make new ones and change all the records to agree with the wheel as finally passed into production. However, if the wheel cannot be made satisfactory by tuning, it is finally rejected. The wheel is now ready to be shrunk on the shaft, but before shrinking it on to the shaft, a careful check is made by the factory inspector of the wheel bore, the serial number and the drawing number and the diameter of the shaft. This data is turned over to the engineering department for final check to insure a tight wheel under operating conditions.

Every wheel in a new design of machine is calculated in like manner. For modified designs of machines, where any departure is made from the original design in wheels, or buckets, this same procedure applies.

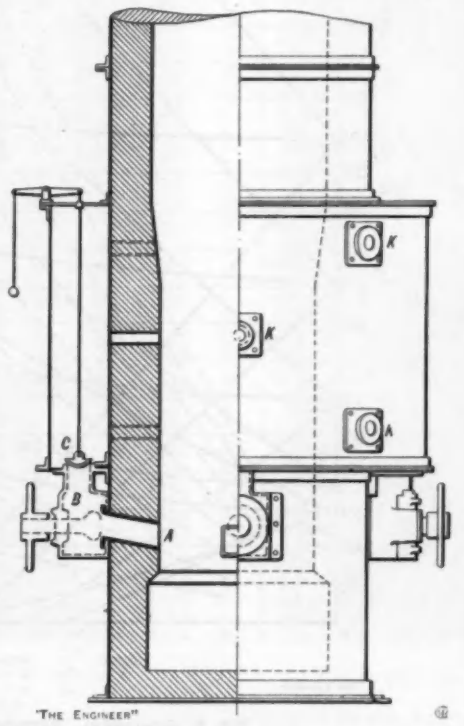
This outline gives an idea of the extreme care which is taken, so as to be sure nothing is taken for granted in the matter of wheel design.

British Railway Results in 1930.

By the continued courtesy of the secretaries of the various companies, in sending us their annual reports, we are able to give herewith a table showing the results of British railway working last year, together with the corresponding figures for 1929. We submit the figures exactly as they appear in the reports. Explanations could be offered for various increases and decreases, but it seems desirable not to attempt anything of that nature, as much would be only conjecture. We would, however, remark that, as in previous years, in the engineering details in Table II., no deductions or additions have been made for transfers to or from reserve funds; the figures are the amounts actually spent.

Balanced Blast Cupola.

"SOME Developments in Foundry Practice" formed the subject of a paper read by Mr. E. Longden at a meeting of the Manchester Association of Engineers held on



BALANCED BLAST CUPOLA

Friday, March 27th. The author said that the most important advance made in cast iron metallurgy was in connection with the control and production at will of a metal with the maximum pearlitic structure. He described the features of the Lantz, Emmel and Mechanite processes for producing pearlitic iron and then proceeded to deal at some length with modern foundry plants, including cupolas, core and mould drying plants, core-making machines, sand treating machines, &c. One of the interesting appliances which the author referred to was a balanced blast cupola which has been developed by the British Cast Iron Research Association and which has been patented in Great Britain. In this cupola, illustrated in the drawing, it is claimed that gases rich in free air exist for some distance in front of and above the tuyere entrance. There is another zone towards the core of the material containing CO_2 with small amounts of free oxygen and nitrogen, and the central core containing principally CO. The object of the cupola is to promote a greater formation of CO in the melting zone and by a gradual addition of further air through upper auxiliary tuyeres to lead to an increase in the CO_2, and a rise in temperature until the maximum temperature zone is reached at the top of the coke bed. It will be noted that the several rows of tuyeres are supplied with air from one wind belt. The main tuyeres A are controlled by ball screw valves B, so that it is possible to regulate the amount of air passing through the main and auxiliary tuyeres K to balance the blast and provide for the varying requirements of the cupola during the heat. The main tuyere valves B are designed to allow the front portions which carry the ball valves to be swung open, enabling the free cleaning of the tuyere mouths during long "blows," valve C being closed. The valve B is hollowand is fitted with a sight glass for inspection of the coke bed. Air pressure can be ascertained by connecting the centre stem of the valve with a pressure gauge. The advantages claimed for this cupola are a considerable economy in fuel consumption, an improvement in the quality of the metal owing to a reduction in the loss of the various elements, and a lower sulphur pick-up from the smaller quantity of fuel used. The saving of fuel is said to be as much as from 20 to 25 per cent.

BOOKS OF REFERENCE.

The Chemical Engineering and Chemical Catalogue. Edited by D. M. Newitt, Ph.D., D.Sc., &c. London: Leonard Hill, Ltd., 231–232, Strand, W.C. 2. Price 15s., or 10s. 6d. annual subscription.—Although this annual has only reached its seventh issue, it has earned for itself a place of definite value. The present edition is arranged in a similar manner to its predecessors. It opens with a catalogue of Chemical Products, Raw Materials, Plant and Equipment. Next come several useful trade indexes, which is followed by a General Reference Section and Tables, and finally, a Technical and Scientific Books Section, concluding with Publishers' Advertisements. The volume is one of real use to all those engaged in the industries covered by it.

Colliery Year Book and Coal Trades Directory, 1931. London: The Louis Cassier Company, Ltd., 22, Henrietta-street, W.C. 2. Price £1 1s. net.—The eighth edition of this reference book contains no new features, but all the information given in the previous issue has been brought up to date. The Coal Mines Act has been passed since the last edition, and its effects are given in full, followed by the usual interesting annual review of the coal mining industry and the coal trade.

A BIG harbour development scheme, necessitating the expenditure of over £5,000,000, is, says the *Far Eastern Review*, being considered by the Manchurian Government and the management of the Peking-Mukden Railway, this being the building of a modern harbour 31ft. deep at Yinghow facing the Gulf of Liaotung. The promoters of the scheme believe that the completion of a modern harbour at Yingkow would prove to be beneficial to the Peking-Mukden Railway, which would then have its own outlet to the sea. The scheme also provides for the construction of three wharves with accommodation for several steamers of over 3000 tons. A series of godowns will also be constructed.

Railway and Road Matters.

SIXTY-TWO thousand steel sleepers of home manufacture are to be laid this year by the Great Western Railway in half-mile to one-mile lengths on various parts of the system. The company already has over 136,000 steel sleepers laid in the permanent way, and this year's programme will bring the total mileage laid with steel sleepers up to 94 miles.

IT was stated by Mr. Morrison on March 25th that the London and North-Eastern Railway Company has now submitted to the Development (Public Utility) Advisory Committee an application for a grant in respect of a revised scheme for the electrification of the Great Northern suburban lines. The right hon. gentleman added that the application would receive careful and immediate consideration.

THE "Queen of Scots" Pullman recently left Leeds three minutes late and lost another twelve minutes by engineering operations. It arrived, however, at King's Cross on time and so covered the 186 miles between Leeds and King's Cross in 186 minutes. The 156 miles from Doncaster took 147 minutes, which was an average of 63·7 m.p.h. for nearly 2½ hours continuously. The engine was "No. 3251."

IT was stated in *The Times* of March 28th that it was understood that a voluntary reduction of salaries in the higher grades of the Great Western Railway service has been agreed upon. The reduction will apply to salaries over £350 a year—that is to say, to those which are above the limit affected by the recent finding of the National Wages Board—and will be at the rate of 5 per cent. The other railway companies are believed to be contemplating reductions on similar lines.

IN addressing the shareholders of the Great Eastern Train Ferries Company on March 31st, Lord Daryngton, the chairman, said that the dismissal of the question of a Channel tunnel had left the way clear for the development of train ferries. Accordingly, certain influential groups on the Continent, having secured control of the existing train ferry terminal at Calais, had indicated their willingness to co-operate with the Great Eastern Train Ferries Company in establishing a new train ferry between France and England.

DURING the three months ended on September 30th last the Assisting Inspecting Officers of the Ministry of Transport held thirty-eight inquiries into the more serious accidents to railway servants. Thirteen of these inquiries turned upon fatal cases, and as in a couple of instances two men lost their lives there were fifteen fatalities. In one of the two cases where two men were killed the cause was ascribed to want of thought and in the other to no look-out man having been provided. The latter cause also contributed to another death, and of the remaining ten men killed seven were attributed to misadventure and three to want of care.

MENTION of the award by the King of the Edward Medal to a plateplayer, in recognition of his gallantry, appears to come within the four walls of this column. On January 14th, a workman, engaged in dismantling a wooden staging fixed across the line of the Metropolitan Railway at King's Cross, slipped and fell 20ft. on to the track of the down Inner Circle line, which, it will be remembered, is electrically operated. The flagman, Arthur Devere Thomas, saw the accident and heard a down train approaching. Appreciating that the latter could not be pulled up in time, he ran and lifted the man out of the four-foot into the recess under the platform wall and held him there until the train was stopped. The official report of the presentation of the medal said: "By reason of his employment, Thomas must have been fully aware of the risks he faced, and he displayed conspicuous gallantry in successfully effecting the rescue of Percival."

ON December 28th last the driver of the engine that had to work a return L. and N.E.R. excursion from Leicester to Leeds found, on his way from the engine shed to Leicester Station, that it was impossible to open the cylinder drain cocks. He adjusted them himself before his train left and did not use them until he reached Doncaster, when he attempted to do so as he was leaving that station, owing to the engine showing a tendency to prime. He then found that they had jammed again and this caused his attention to be diverted from the platform starting signal and he overran it and allowed his train to collide with a goods train. The examination of the engine after the accident revealed that the length of one of the rods actuating the cylinder and steam chest drain cocks was such that in the off position it, and the lever on the plug of the cock connected to it, were in line; consequently an attempt to open the cock by pushing the lever was liable to cause the mechanism as a whole to jam.

THE fatal derailment of March 19th at Etampes, on the Paris-Orleans Railway, referred to in this column and in the "French Engineering Notes" of our issue of March 27th, is hardly likely to have been caused by the points being moved under the train. Facing point locking bars, universally used all over the world, prevent that, as the presence of a wheel on the bar holds the facing point lock plunger in the points, and the latter cannot therefore be moved whilst a train is on or moving over them. That safeguard was invented in 1867 by Livesey, Edwards and Jeffreys, and it is interesting to know that John Saxby did not invent the facing point lock itself until 1870. A great stimulus to the use of the locking bar was given by the derailment of the down "Tourist" express at Wigan on August 2nd, 1873, when thirteen passengers were killed. The cause of the derailment was never satisfactorily cleared up, and on that account the London and North-Western fought—and lost—an important claim for damages. On that occasion Sir John Fowler said that the locking bar was the greatest improvement he was acquainted with. With the longer wheel base of modern rolling stock the bars have had to be lengthened to 45ft. and 50ft., and thus are a great weight for the signalmen to have to move. That objection has now been overcome by a length of track circuit at the points, as the presence of wheels at or near the points short circuits the track circuit current of a relay on the facing point lever so that the latter cannot be moved until the relay is again energised.

Notes and Memoranda.

BY using sheet aluminium alloy, instead of galvanised steel, for the shutters of the locomotive round-house at Williamstown, belonging to the Norfolk and Western Railroad, Virginia, their weight has been reduced from 1080 lb. each to 323 lb., and much lighter operating gear can be employed. Time is also saved in opening and shutting, and painting is unnecessary.

AN editorial article in the *Chemical Trade Journal* is concerned with the dehydration of commercial gases, such as coal and coke oven gas. The several different systems in vogue are mentioned, but it appears that the author of the article considers the bubbling of the gas through a concentrated solution of calcium chloride as being the most promising. With this system little new material is required, as the chloride is continuously regenerated.

AN ingenious system of steel studding for partition work in buildings has been devised by the Wheeling Corrugating Company of America. The studding is made of sheet steel folded to form a T, with a double thickness in the web. At the bottom of the web the fold is not closed tight together, so that there is a small hollow there. Nails, for the attachment of wall boards, can be driven between the two limbs of the web, and on meeting the bottom of the hollow the point curls up on itself, holding the nail securely.

A PROCESS for making concrete floors, such as those of explosive magazines, immune from sparking, is described in the *Engineering News-Record* as follows:—The thoroughly cleaned concrete floor surface was treated with a solution of 3 lb. of castile soap completely dissolved in 4 gallons of water. This solution was applied liberally to the surface at a temperature not less than 200 deg. Fah., and worked into the surface with a long-handled brush in a manner to remove air bubbles, without forming a lather. After thoroughly drying, the floor was treated with a solution of ½ lb. of potassium alum dissolved in 4 gallons of lukewarm water. When this application had dried, another complete treatment of soap and water, followed by alum and water, was repeated. After drying again, the floor was finally washed to remove the light coating of potash which formed on the surface. On floors treated in this way it was practically impossible to draw sparks by striking the concrete surface with hard objects.

AN interesting demonstration of the distance the human voice can be made to carry above the noise of traffic, was recently given in conjunction with Captain A. G. D. West's concluding Cantor Lecture at the Royal Society of Arts on "The Recording and Reproducing of Sound." A loud speaker was mounted on a van in a street near Waterloo Bridge on the south side of the river, and gramophone records and speeches in which the human voice was amplified two million times, were transmitted a distance of about half a mile across the river to an audience on Adelphi-terrace, Strand. The speeches and music were heard quite clearly in spite of the traffic along the Embankment. The loud speaker had a wooden diaphragm which measured about 2½ft. across, ten valves were used, and the actual power radiated was about 20 W. The microphone was designed by Captain West, and was constructed by the Gramophone Company (His Master's Voice) at its Research Department at Hayes. This was the first test in London.

IN Arnheim, states the *Electrical Review*, seven schools are heated electrically. These buildings are of modern construction, and nearly all have seven class-rooms, and, in addition, a room for the head teacher and another for the staff. School hours are from 9 a.m. to noon and from 2 p.m. to 4 p.m.—except on Wednesdays and Saturdays—so that the maximum demand of from 75 kW to 80 kW per school is not made during the peak hours, which are between 4 p.m. and 7 p.m. Electricity is supplied at 0·6d. per kWh during off-peak hours and 2d. per kWh at the peak, when very little energy is taken. Luminous or dark luminous radiators are used, except in the open-air school, and in one class-room of another school where so-called "Sun" fires are installed on the ceilings or high up on the walls. The luminous radiators—10·5 kW to 12 kW in each case—are placed above the plinths about 8in. from the floor, both under the windows and on the other three sides of each class-room, thus giving a regular and equal temperature at all parts. The class-rooms each have a cubic capacity of about 6300 cubic feet, and accommodate from thirty-six to forty children. The consumption per annum ranges from about 19,000 kWh to 40,000 kWh, the lay schools using noticeably more energy than those belonging to religious bodies. Electric heating meets with the entire approval of the teaching staffs.

VARIOUS suggestions have from time to time been put forward to reduce the great amount of space occupied by the lifts in a modern American skyscraper. The large number of floors that have to be served and the necessity for speedy transport to any floor require the provision of a number of lift shafts which, in consequence, often occupy very valuable space in the higher stories. In the new building now being erected for Henry L. Doherty and Co. and the Cities Service Company, it has been decided to install double-deck lifts, or two lifts in a single shaft, which, it is claimed, will save half the space ordinarily devoted to shafts. The lifts will be loaded at two levels simultaneously, there being two main entrances to the building, one on an upper and one on a lower level. Whilst the compartments on the upper level are being loaded with passengers for all odd-numbered floors from the twenty-ninth to the fifty-ninth—the double decker will only serve the tower floors—the lower compartments will take on passengers for all even-numbered floors from the twenty-eighth to the fifty-eighth floor. Each compartment will be equipped with complete operating devices, and it will be necessary for both operating levers to be in the full start position with the hatchway and car doors closed before the whole lift will start. The lifts will be of the latest automatic control type, and will travel at the rate of 1000ft. per minute. From this development it is only another step to the system of two independent lifts in one shaft, one a local, one an express, which has already been pronounced practicable and safe by some experts.

Miscellanea.

IT is proposed to illuminate the Rand air port at Germiston at a cost of £10,146.

A NEW 80-ton crane is to be installed on the Congella Wharf, Durban, at a cost of £11,930.

THE first consignment of vanadium from the Rhodesia Broken Hill Development Company's mines has been shipped for export.

OPERATIONS have been started on the second stage of the Lochaber hydro-electric scheme of the British Aluminium Company.

A NEW company with a capital of £T250,000, has been formed in Turkey for developing chrome ore deposits and exporting the material.

A PLANT for the manufacture of phenol and allied tar products, such as those used in the composition of Bakelite, is being put up at Toronto, Ontario.

THE International Telephone and Telegraph Corporation of America has inaugurated a radiophone service between Australia and Argentina, Uruguay and Chile.

ON account of a wages dispute night work has been stopped in the iron and steel, engineering, mining, textile, building and several other trades of Norway.

PRELIMINARY operations for the exploration of coal and oil deposits on Sakhalin Island are now being carried out, and some mines are being prepared for exploitation.

A NEW submarine record for the United States Fleet has been set up by the submarine "V 6," also known as the "Nautilus," which recently reached a depth of 336ft.

THE Home Office draft regulations concerning the chromium plating industry, which were issued a year ago, have been revised. The Home Secretary believes that they will now meet with the approval of the trade.

IT is pleasing to hear from South Africa that Captain W. Rodick has safely taken the dredger "Rietbok" to Durban, for he is eighty years old, and has been in the service of the vessel's builders for fifty-five years. During that time he has navigated seventy steamers from W. Simon and Co.'s yard to their destinations.

ANOTHER effort is to be made to extract oil from the torbanite deposits of the Ermelo district of South Africa. A new company has acquired 21,000 acres of land, which is claimed to be sufficient to maintain an oil-producing industry on an economic basis for 87 years. The problem of extracting the oil from the torbanite is said to have been solved by an inexpensive process recently invented.

NEW industrial plants, representing a capital investment of £4,463,000, were established along the Western lines of the Canadian National Railways alone during 1930, according to a report of the company's Industrial Department. The new factories include power plants, bakeries, dairies, steel fabricating plants and paper companies. In addition to the new establishments, extensive additions to existing factories were carried out.

IN view of the urgent need for the dredging and improvement of the lower reaches of the Yangtsze River, in China, a conservancy programme entailing the expenditure of some £5,000,000 for the Woosung-Hankow section of the river has been formulated by the Yangtsze River Conservancy Board under the Ministry of Communications. In order to raise the necessary funds, the levy of a surtax on goods transported to various ports on the Yangtsze Valley is contemplated.

THE total net sea-going tonnage which entered Bremen in February was 574,317 tons, of which 390,962 tons, or 69 per cent., belonged to Germany. Great Britain's share was 53,068 tons, or 9 per cent., her figures showing an increase over the previous month of 1 per cent. Holland, which occupied second place in January, came third in February with 37,172 tons, or 6·5 per cent. The United States came next with 52,531 tons, or 6 per cent.; Norway took fifth place with 10,465 tons; then followed Danzig, Japan, Italy, and France in the order given.

THE Safety in Mines Research Board has issued a report—No. 63—of an investigation by H. E. Newall and F. S. Sinnatt on the "Propagation of Combustion in Powdered Coal." The smouldering of coal dust can be propagated at temperatures above 130 deg. at a speed which depends on conditions, but can be so low as 5in. per hour. It was shown that appreciable quantities of hydrocyanic acid were evolved on combustion at 500 deg. to 600 deg., which suggests the existence of an additional and unsuspected hazard associated with spontaneous combustion.

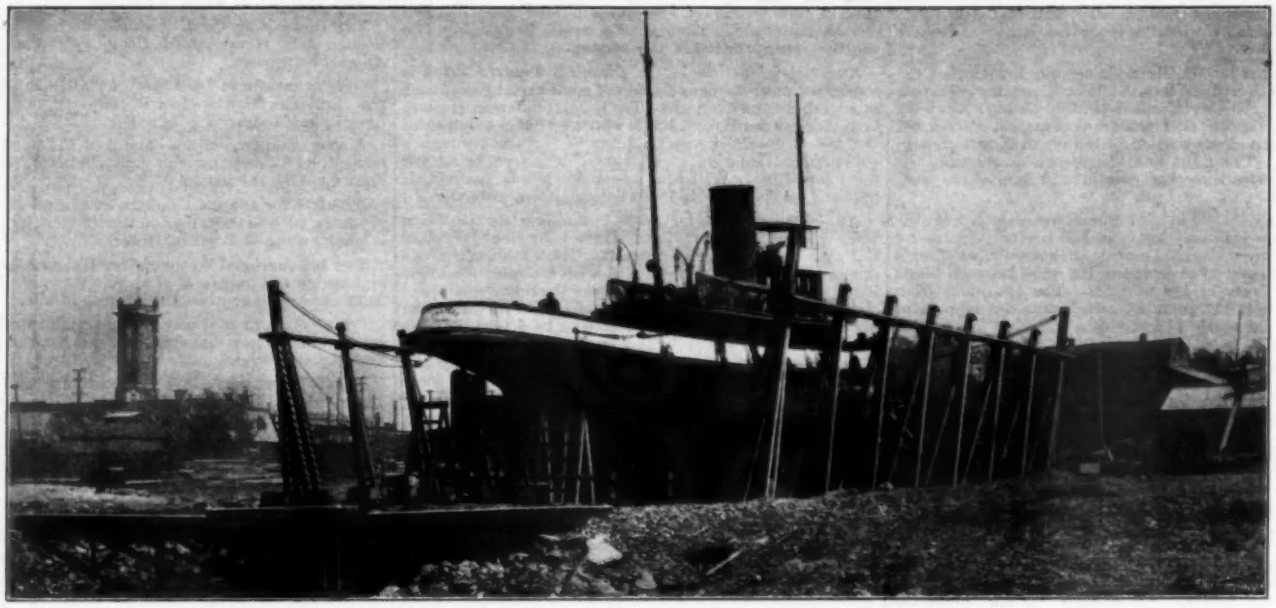
THE American Secretary of War has transmitted to Congress the report of the Chief of Engineers on the preliminary examination and survey of the Cape Cod Canal. The report recommends a modification of the existing project to provide a lock canal with one lock instead of the present sea level canal. The lock is to be 110ft. wide and 1000ft. in usable length, with 40ft. over the sills. The depths in the canal and approaches will be 30ft. with a width of 250ft. in the land cut, a width through Buzzards Bay of 400ft. to Wings Neck in a new straight alignment and of 700ft. beyond Wings Neck. The report also recommends a highway bridge of adequate vertical clearance, a railway crossing, and a 15ft. channel into Onset Bay.

THE Quebec Government, by Order-in-Council, has granted permission to the Beauharnois Light, Heat and Power Company to divert an additional flow of water from the St. Lawrence River to enable the company to develop a greater amount of electricity at the development taking place 25 miles above Montreal. The company is given a lease to rights of the province for the diversion of 30,000 cubic feet of water per second in addition to the 40,000 cubic feet already conceded, and the quantity in rights which the company secured from the Montreal Cotton Company, namely, 13,072 cubic feet per second. The new lease is to run to June 23rd, 2003, terminating on the same date as the rights granted on June 23rd, 1928, for a period of 75 years. The company is to pay additional rental of 37,500 dollars per year and a royalty of 1 dollar per horse-power per year.

RAILWAY DRY DOCKS AT QUEBEC

THE CRANDALL ENGINEERING COMPANY, BOSTON, MASS., ENGINEERS

(*For description see page 400.*)



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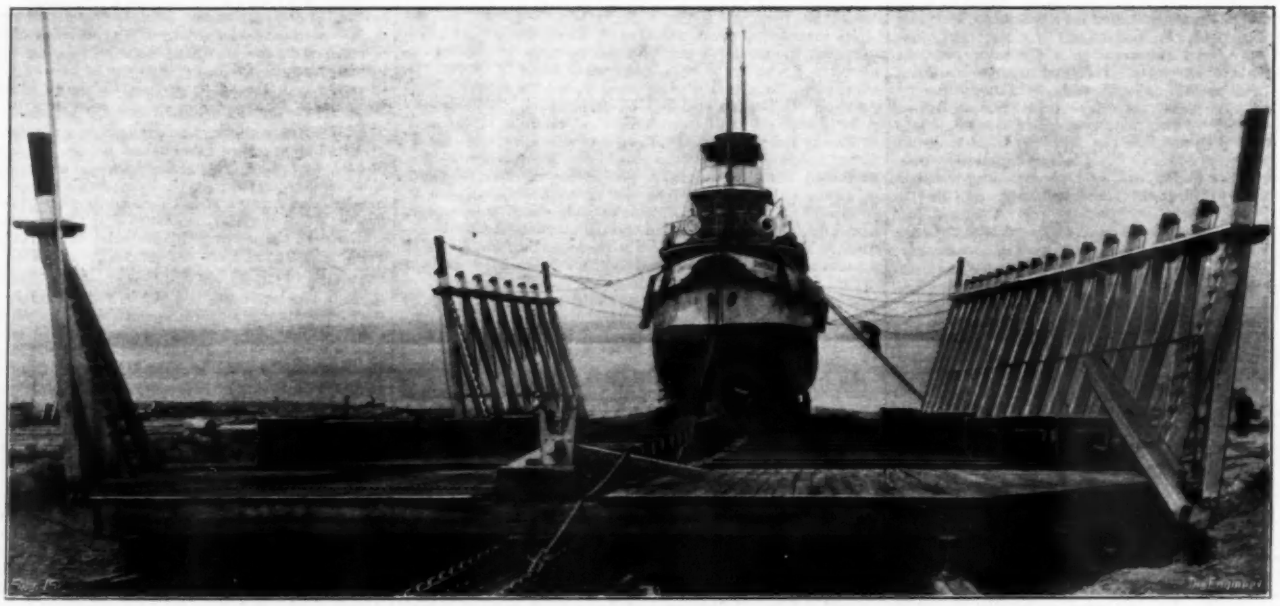

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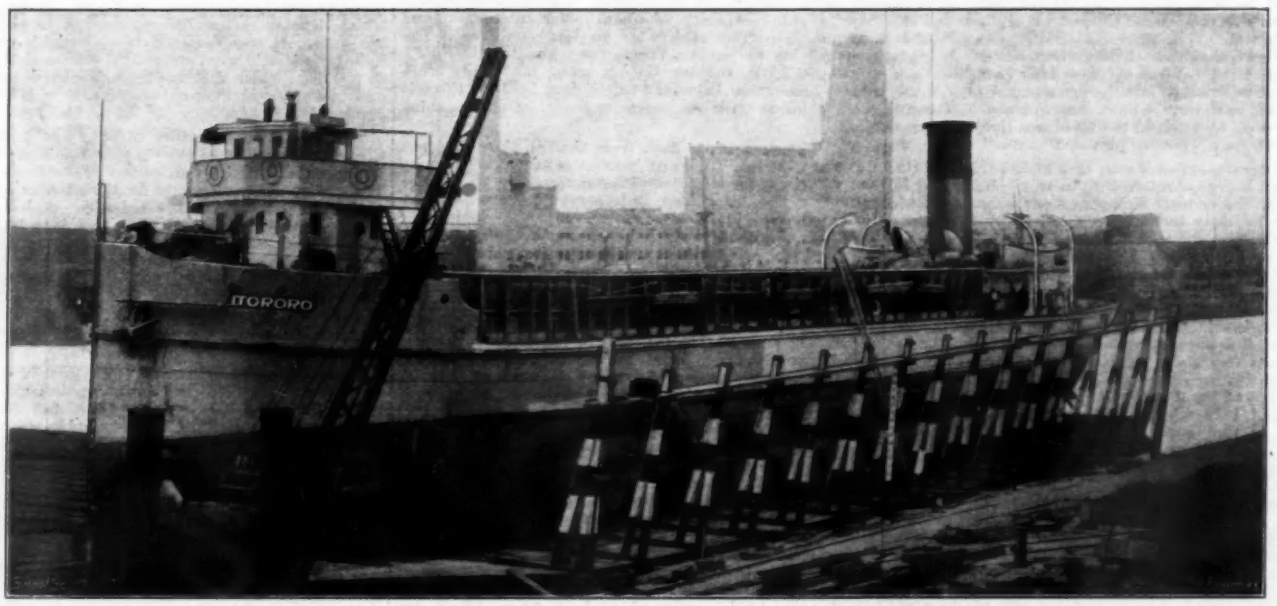

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THE ENGINEER.

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APRIL 10, 1931.

Electric Heating.

WHEN it is remembered that a kilowatt-hour only represents 3415 B.Th.U's, whilst a pennyworth of coke at 40s. per ton contains 58,400 B.Th.U's, the position of electric heating appears pretty hopeless. Looking at the matter from this standpoint, the electrical engineer does not seem to stand very much chance of ever gaining a very firm footing in the business of heating buildings, yet according to a paper read before the Institution of Electrical Engineers by Mr. Ronald Grierson on Thursday, March 26th, he has every reason to be optimistic. The author maintains that it is practically impossible to secure reliable and comparative figures covering the performance of rival systems, for, up to the present, no one has spent, say, £5000 or £10,000, in equipping a large building with a particular warming system, tested it out for a number of years, entirely removed it, replaced it with another system and tested the new equipment under the same conditions. Just as it has been argued, when comparing the cost of electric lighting with that of gas, that other factors must be considered besides the sum paid for the electricity or gas, so does Mr. Grierson contend that it is altogether unfair to compare heating systems on the basis of the B.Th.U's in a pennyworth of coke and in a unit of electricity. The picture, he explains, must be considered as a whole, including the hygienic and physiological aspects, and a cash value must be placed on the effect of different systems upon the mental activity of the clerical or other staff employed in the rooms so heated. Repairs and maintenance, attendance, and other factors must also be taken into account.

Nevertheless, many contend that when all the alleged advantages of electric heating are considered, it is still more expensive than other methods of warming buildings. As the discussion clearly indicated, even some electrical engineers are not by any means convinced that the electrical system is economic. Dr. Alfred Ekström explained that when, in 1912, the question of heating the new Town Hall at Stockholm arose, the offices of the construction staff were provided with two heating systems for the purpose of a test. Besides electric radiators, there were radiators heated by warm water produced by a coke-fired boiler in the cellar of the building. Briefly, it was found, after taking into account the various factors mentioned in Mr. Grierson's paper, that with electricity at 0·67d. per unit and with coke at £2 4s. per ton the annual cost of electric heating was almost 3½ times as great as that for warm water heating. With coke at 37s. per ton, as quoted by the author, it would have been nearly 4½ times more costly than the water system. On the other hand, Mr. Grierson claims that when the price per unit is between 0·5d. and 0·75d. electric heating of all types, and particularly the low-temperature electric ceiling panel system under automatic temperature control, becomes a serious competitor of the coke-fired boiler system, when all the correlated costs of labour, maintenance, capital charges, &c., are taken into account. The most slashing criticism came from Mr. Kilburn Scott, who expressed the view that to talk of heating schools, churches, hospitals, &c., by means of electricity was unadulterated nonsense. What British electrical engineers ought to do, Mr. Scott went on to explain, was to follow the example set ten years ago in Pittsburg, where, instead of entirely shutting down small stations, a supply company utilised the boilers for supplying steam for heating all the large buildings in the vicinity. Since that scheme was first put into operation, when the electrical load was transferred to large stations outside the city, the steam-heating load had increased to such an extent that the original boilers had been replaced by some of the largest boilers in the world, each of them evaporating no less than 400,000 lb. of water per hour. Most of the other speakers, however, were in sympathy with the author, who has, apparently, installed the panel system of electric heating in a number of important buildings in this country. To a large extent the discussion was devoted to the relative merits of different electric heating systems which are now in use. With the thermal storage systems, which owes its existence to the fact that certain supply undertakings are offering specially reduced rates for electric energy used during the night, the author appears to have little sympathy. So many appliances are needed to enable advantage to be taken of the reduced prices that it is considered that these prices must be very substantially lower than those normally offered for low-temperature thermostatically controlled electric heating systems. In fact, the author proves to his own satisfaction that to compete with the electric ceiling panel system with thermostatic control operating with current at 0·75d. per unit, the thermal storage system must be supplied with current at 0·25d. per unit. With this opinion, however, some of the speakers did not agree; in fact, the general view seemed to be that Mr. Grierson had been unfair to the thermal storage system. From the supply undertaking's point of view, it is more attractive than any other system, because it provides an "off peak" load, and, according to Mr. R. P. Sloan, of the Newcastle-on-Tyne Electric Supply Company, it would pay to provide current at 0·3d. per unit.

Those who attended the meeting with the object of discovering what future electric heating has before it, and who have not given special attention to the matter themselves, must have found it rather difficult to arrive at a definite conclusion. The value of the discussion would have been enhanced if more supply engineers had taken part in it, for much depends on how anxious these people are to acquire a heating load. In order to encourage electric-heating current must be supplied at exceptionally low rates, and it does not follow that a consumer who uses electric radiators for heating his house is a valuable asset to the supply undertaking. Some engineers contend that undertakings that are willing to supply electricity for heating at a flat rate of 0·5d. or 0·75d., irrespective of whether the demand will increase the peak load or not, are liable to incur a loss which must be made up by consumers using electricity for other purposes. The prices paid for bulk supplies from the "grid" and the extra cost of distribution resulting from the heating load are matters which are bound to have a profound influence on the progress of electric heating. On the other hand, there are, of course, people who will adopt it even if it is more expensive than other methods of heating. The fact that an electric radiator can be placed under a table or in practically any other position; that it gives off no fumes and does not damage decorations, are advantages for which some are ready to pay. Others, however, prefer the cosy and cheerful

appearance of a coal fire, and are ready to put up with its dirt and other inconveniences. Personal taste often plays a part in the choice of a heating system, although in many cases, and particularly in the case of heating large business establishments, cost is the main governing factor. For lighting and power electricity has proved to be a serious competitor to gas, but whether it will ever be widely used for heating is another matter. The number of people who use electric heating must be very small when compared with the number that use other heating systems. In many cases the modern and convenient gas fire seems to give satisfaction, and we suspect that electrical engineers will find it difficult to displace.

Shipping Interests and Freights.

The activity of shipping is a good index to the condition of world trade. But it is something more, for a slump in freights and the laying up of shipping bring into greater relief the causes of universal trade depression than can interminable dissertations on economics. The shipowner views the trade routes of the world and regards matters from the standpoint of general interest, to the exclusion of those partial interests which are responsible for the present state of things. He condemns anything that interferes with traffic over those routes. At present, everything is condemned. To the shipowner the situation is as bad as it possibly can be. In the annual report of the Comité Central des Armateurs de France (Central Committee of Shipowners of France), the Vice-president, Monsieur de Rousiers, states truths about general principles that are now fairly obvious to everyone, but are generally set aside because their application would involve an operation extremely unpleasant, and perhaps dangerous, to the patient. The trouble arises, he holds, from there being two contrary forces at work. On the one hand, there have been greatly improved facilities for land, air, and sea travel, whereby quicker, easier, and cheaper communication is provided. On the other hand, there has been a closing of markets by tariff barriers which is leaving a constantly diminishing quantity of merchandise available for transport. In countries in which new industries have to be protected the imposition of higher duties may be excused, and the results would not be so disastrous if limited to those special cases, but the Comité Central des Armateurs lays the blame chiefly on the United States, where the industrial and economic conditions do not, in its opinion, justify a policy which aims at restricting commercial exchanges. Fiscal tariffs are now regarded as a means of raising revenue, and as a measure of defence against unequal production costs in other countries. So long as that inequality exists, there can be no question of reducing tariffs. It has become an urgent necessity, in many cases, to choose an alternative to import duties or restriction of imports. This has made the situation apparently inextricable. The German move towards free trade with Austria, accompanied by an invitation to other countries to join the combination, is the boldest attempt to cut the Gordian knot that has yet been made. The invitation has the appearance of a formality which Germany knows cannot be accepted by other countries under present conditions. Nevertheless, the influence of that policy may give a new trend to the negotiations for a European collaboration. Meanwhile, this does not help shipowners, who find much to cause them serious concern. There is, for example, the shipment of Russian anthracite from the Black Sea to Canada. How that is done is a mystery that has yet to be elucidated. It will have to be taken into account by shipowners in the future.

The troubles of to-day are attributed by Monsieur de Rousiers to stagnation, disorder, and a glutting of markets. Goods cannot be sold because it costs too much to produce them, and it is only when they are shipped freely from producing to consuming countries that the situation will become normal. The cost of production is too high because there is a fallacious idea of what constitutes a standard of living. That is a fetish which is based upon erroneous impressions of the purchasing value of wages. Labour cannot fix its own wages independently of the purchasing power of consumers without incurring the risk of losing its wages altogether. Already high wages are reduced indirectly by the necessity of paying doles to the vast army of men who are out of work because wages have been established on an uneconomic basis. The standard of living is measured not by the level of wages paid, but by what can be purchased with them. This is a truism which it appears difficult to make understood. Within reason, a lowering of wages that are obviously high under existing conditions means a more than corresponding decrease of manufacturing costs, and the selling of goods more cheaply would logically improve the standard of living. Workers would be able to buy more with their wages. The standard of living is regulated not by the wages received by certain categories of workers, but by the margin between the wages paid to a fully employed population and the cost of essential products. Another fact is that an exporting country like Great Britain cannot maintain a standard of wages as distinct from a standard of living in face of much cheaper conditions of production in competing countries. The export trade depends more than at any previous period on selling prices. Goods of the best quality generally remain unsold if they are offered at prices which the foreign consumer is unable or unwilling to pay. The heavy depreciation of values of produce all over the world has left the purchasing power of buyers abroad much lower than it was formerly. Consumers cannot afford to pay higher prices, even for quality, and production costs at home must therefore be adjusted to the customers' ability to pay. In some markets British goods have the reputation of being so costly that no one will even entertain the idea of purchasing them. That is a bad state of things for a country which depends very largely on its export trade. It is, of course, due in great measure to the foreign tariffs against imported goods, but they do not stop the importation of manufactured products from some competing countries. The situation is unfortunate, but it must be faced, and sacrifices must be made until conditions improve.

All this is of vital interest to shipping, which is confronted with the same problems of wages and charges. The Comité Central des Armateurs de France deplores the burdens that are imposed upon shipowners by the application of the eight hours' day to the French marine, and of restrictive measures which prevent them from effecting economies at a time when they are most needed. Notwithstanding these burdens, the French shipping industry has succeeded in increasing its tonnage to nearly three and a half millions, and the decline in the quantity of goods carried is less marked than in most other merchant marines. But the effort has entailed great sacrifices on the part of shipowners. Monsieur de Rousiers affirms that they have done all they can to collaborate actively in the world's economic reconstruction. Now the Comité can only remain passive while the various committees endeavour to facilitate commercial exchanges by international agreements for regulating production and encouraging consumption. These negotiations have been pursued for many years with results that, so far, have merely revealed the extraordinary difficulties that stand in the way of a satisfactory solution. The attempt to make the Continent a closed market by ensuring an interchange of produce and manufactured goods between agricultural and industrial countries has encountered almost insuperable obstacles. As Great Britain is the largest importer of foodstuffs, the success of the proposed union depends upon this country being drawn into it, but it cannot act independently of the Dominions. For that reason, at the instigation of Canada, the International Wheat Congress—which recently held abortive meetings at Rome—will gather again shortly in London. All these discussions have shown the complicated character of negotiations which are rendered doubly difficult by conflicting economic and political interests. Meanwhile one of the most serious dangers confronting shipowners is the collapse in coastal freights, owing to the continental competition in the coal trade. The freights from Danzig to the French ports are abnormally low. There is a danger of this condition spreading, and shipowners are more anxious than others to see something done to promote the international agreements to which Monsieur de Rousiers refers.

A Notable Meeting.

It is fitting that a word or two should be said about the great meeting held in the hall of the Institution of Mechanical Engineers on the last day of March. On many occasions three, four, or five societies have met for the purpose of discussion, but we believe the meeting to which we refer, and of which some account is given on page 409, was the first in which as many as eleven distinct societies took part. It was a complete success, and the thanks of engineers are due to the Institution of Automobile Engineers by which it was organised. We say it was a complete success, but the adjective must be qualified, for, as was inevitable, the meeting had the defects of its merits. Very wisely, a single paper was read, but that paper presented numerous facets, and, in consequence, more people wanted to take part in the discussion than time would permit. We can recall meetings in days gone by when discussions were almost still-born, but, since the "stage-management" of discussion—which we believe this paper was the first to advocate and the Institution of Automobile Engineers the first to adopt—has become the common practice, the pendulum has swung in the opposite direction. Generally, the chairman finds that he has more names on his list of speakers than can be accommodated in the available time, and those who may be described as spontaneous speakers are rarely heard. That has its disadvantages, but it is very difficult to see how it is to be avoided. Indeed, the whole question of the management of technical discussions is a very complex one. But, whilst the unavoidable curtailment of the discussion last week must have caused some disappointment, it does not detract in the slightest from the fact that a large number of the technical institutions of London had come together in common meeting. That seems to us to be the essential point. Co-operation and mutual understanding between the learned societies is very desirable on all grounds, and anything that conduces to it is to be welcomed, whatever minor defects it may have.

The R 101 Inquiry.

By Major P. L. Teed, A.R.S.M., A.I.M.M.

Six months after the disaster to the world's largest airship the report of the inquiry conducted by Sir John Simon into its causes has become available. This document, of some 129 pages, shows, as would certainly be expected from its distinguished and public-spirited author, that no labour has been spared in seeking material relevant to his purpose. No harsh judgment is passed on those associated with the enterprise, whose undoubted courage, ability, and enthusiasm in attempting a task of the very greatest difficulty, was so malignly rewarded.

That the report, unlike that on the proportionally equally disastrous Meopham aeroplane accident, fails to supply a complete statement of the sequence of events whereby, in a space of something under two minutes, "R 101" was reduced from one of the contemporary engineering wonders of the world to being the funeral pyre of forty-nine gallant adventurers, is no disparagement, either of the industry or of the ability of its author and his technical advisers, but rather constitutes proof of the complexity of the problem with which they were faced.

From the consideration of the evidence in the light of fundamental scientific principles, it is abundantly clear that the primary cause of disaster was loss of buoyancy arising, in the main, from loss of hydrogen. From aerodynamic calculations based on the most elaborate wind tunnel experiments, it can be said with equal certainty that this escape of gas was chiefly located forward of the centre of buoyancy of the ship, and, further, that it was of such magnitude that the pitching moment thus brought into being could not be overcome, certainly in the time available, if at all, by the combined use of the elevators and the dropping of disposable weights.

As to why there should have been such a loss of gas, the report exercises, in view of the almost complete lack of evidence bearing on this point, an entirely prudent measure of reticence. It is probable, however, from investigations made prior and subsequent to the accident, that when the vessel was rolling, as she undoubtedly did on her last and stormy flight, the moving part of each of the twenty-seven gas valves would have chattered on its seat. While the escape of hydrogen from this cause might in time have become serious, the incidence of the resulting heaviness would have been progressive and not sudden, and its location would have been distributed and not limited to a zone forward of the centre of buoyancy.

It is clear that while the design of the novel and most ingenious system of supporting and bringing the lift of the gasbags into the main frames of the structure would have prevented them—as is claimed in the patent covering the invention—from touching any portion of the framework, the system was not correctly installed. Indeed, so defective was the adjustment of the wiring that it was possible, if not probable, that chafing of the gasbag fabric occurred intermittently in flight at some 4000 places on the structure.

The magnitude of these defects in the installation of the wiring system had been appreciated by those in authority at the Royal Airship Works, and, with the concurrence of the responsible official at the Air Ministry, who was unfortunately without airship experience, an attempt was made to meet what was

recognised as a danger, not by readjustment of the wiring, which would have taken time which could ill be spared, but by a system of padding which, because of the pressure of considerations of policy and the absence of opportunity, was subjected to no adequate trial.

While from such limited observations as were made, it is improbable that the padding effectively prevented chafing culminating in holes, their magnitude would not have been of such size as to have allowed of a sudden loss of gas, but, as with the valves, would have produced a progressive and ultimately detectable general heaviness. However, though the factor of safety of the gasbag fabric was of the order of 20, the fact that chafing had some tendency to occur in lines, some of which would be parallel with the warp of the cloth, admits of the possibility of local damage suddenly spreading from hole to hole.

Even accepting this surmise, from a knowledge of rates of hydrogen outflow from slits, it is difficult, though not impossible, to visualise the rapid development of such a tear as would give a rate of discharge which would account for the airship's transition, within the space of something like one minute, from the controllable to the absolutely uncontrollable state.

While no impartially minded man capable of scientific reasoning can doubt, from the carefully compiled evidence in the report, that a sudden and very large escape of hydrogen was the cause of the catastrophe, it is impossible, merely on this assumption alone, to explain the fairly well-established flight path of the falling ship.

As a result of the most painstaking and elaborate calculations, the National Physical Laboratory has been able to show that if superimposed on an assumed gas loss of some 180,000 cubic feet from gasbag No. 3, growing at the rate of 60,000 cubic feet per minute, the drag of the ship were abnormally increased by a tear in the outer cover and the vessel were subsequently struck by a gust such as would have been possible in the weather prevailing on the morning of October 5th, the vessel would have followed a downward course closely approximating to that which there is strong evidence she did, in fact, take. While the absolute validity of the calculations cannot be in doubt, not everybody, including some of ripe airship experience, will be prepared to accept the whole series of assumptions on which they have been based.

The inquiry has without the slightest question found the primary cause of this disaster, but whether it has been equally successful in determining the circumstances which were the decisive factors after the vessel had passed out of control, in governing its flight path during the last two minutes of its existence, is not so certain. It should be noted that Sir John Simon makes no claim to have done so, but merely points out that one set of assumptions which have been made would give such a flight path as was observed. He very fairly refrains from contending that other causes could not have produced a similar result.

In conclusion, while it can be safely said that "R 101" was the victim of entirely preventable defects, the significance of which was not appreciated by those whose duty it was to exercise a critical supervision over the work of the very able staff of the Royal Airship Works, the disaster raises a question larger than the fixing of responsibility for the failure of the organisation set up to carry out the 1924 Airship Programme. It is absolutely essential that before any further State expenditure on lighter-than-air experiment is incurred, the whole problem should be subjected to the most searching and impartial technical and economic scrutiny. It is imperative to establish what, in the present state of the art, the airship can do, and to determine whether from the Imperial point of view it is worth doing.

Injection, Ignition and Combustion in High-speed Oil Engines.

THE "omnibus" meeting which was organised by the Institution of Automobile Engineers, to hear and discuss the paper presented by S. J. Davies, Ph.D., M.Sc., and E. Giffen, M.Sc., of King's College, London, on "Injection, Ignition and Combustion in High-speed Oil Engines," and which took place at the Institution of Mechanical Engineers, Storey's-gate, on the evening of Tuesday of last week, March 31st, was a most successful event from all points of view. By a co-ordination of interests, which we believe to be the first of its kind, members of the Chemical Engineering Group, the Diesel Engine Users Association, the Institute of Fuel, the Institute of Marine Engineers, the Institution of Automobile Engineers, the Institution of Engineers-in-Charge, the Institution of Mechanical Engineers, the Institution of Petroleum Technologists, the Junior Institution of Engineers, the Royal Aeronautical Society, and the Society of Engineers were present. The large hall was crowded and a very full discussion followed the paper. At the outset, in the regretted absence of the President of the Institution of Automobile Engineers, Mr. W. A. Tookey, President-Elect, explained the origin of the meeting and asked Mr. Loughnan Pendred, Past-President of the Institution of Mechanical Engineers, to take the chair. Mr. Pendred, by wisely limiting the authors to a little less than half-an-hour for presenting a summary of the paper, was able to secure over two hours for the speakers nominated by the various institutions and societies and others interested.

In what follows we give a *résumé* of the principal points raised in the paper and in the discussion.

In presenting the paper, Dr. Davies paid tribute to the early work of British engineers in connection with airless injection, and pointed out that up to 1920 practically all the experience with that type of injection was gained in our own country. This pioneer work, taken in conjunction with accurate workmanship and careful design, had greatly contributed to the more recent very rapid development of the type of engine under discussion. The lineal descendants of the earlier airless injection engines could now be divided into three main types, according as to whether "direct injection," "ante-chamber injection," or "auxiliary air chamber injection" was used, although the last-named type was really a special case of the direct injection principle.

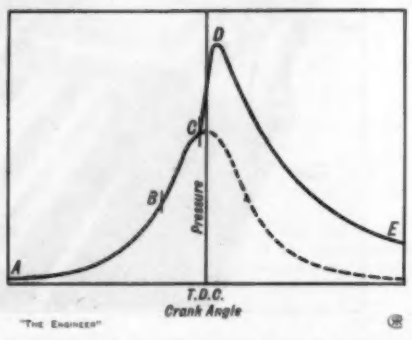
The authors gave an interesting diagram showing the practically unchanged delivery performance of a Robert Bosch fuel pump after over 80,000 hours' service in a commercial lorry, compared with a new pump. Several speakers referred to these curves, and further information as to the temperature and viscosity of the oils used was sought.

The authors commented on the incomplete information which is available on the physical characteristics of even the commonest fuels and gave results of D. H. Alexander's experiments on the compressibility of fuel oil, and R. S. Jessup's tests on the effect of temperature on the compressibility of shale oil. Jessup showed that while pressure did not greatly affect bulk modulus, temperature exerted a considerable influence. The bulk modulus of elasticity was also reduced by 3 per cent. by pipe expansion in the case of a steel pipe and by 7 per cent. in a brass pipe. Any disturbance such as a pressure wave carried by the compression stroke of the pump or by the closing of a spring-loaded delivery valve was propagated along the pipe with the speed of sound. The speed was directly proportional to the square root of the bulk modulus and varied inversely as the square root of the density. It had a value of about 4000ft. per second. Such waves might be wholly or partially reflected back at the nozzle end and might again be reflected at the pump end to move towards the nozzle. During injection such waves might travel to and fro and affect the building up of pressure at the nozzle, so that they required to be taken into account.

By means of a diagram the authors showed the building up of pressure in a typical fuel system, and indicated the injection lag, which was proportional to pipe length when plotted on a time base, the calculated nozzle and pipe velocities should be a stepped form, which followed from the constant plunger velocity assumed, but which would give a fair curve with an increasing plunger velocity. In the example taken, delivery from the pump continued for 0·004 sec. and injection with a 23in. pipe required 0·0064 sec. and 0·0052 sec. with an 11¼in. pipe. The velocity with the shorter pipe increased more quickly and reached a higher maximum pressure, namely, 955ft. per second, as against 835ft. per second, while the cut-off was more sharply defined. With a shorter pipe the re-expanded volume was also reduced.

Dealing with the case of a spring-loaded valve, it was pointed out that the reflection at the nozzle end was complete until the valve opened, while at closing a pressure wave was sent towards the pump; if on its return the pressure was sufficient to open the valve, an undesirable secondary injection might take place. These characteristics were admirably illustrated by pressure diagrams taken by the English Electric Company, Ltd., at Rugby, which showed the pressure waves and the effect of pipe length. In the present state of knowledge it would appear that the correlation of the injection process with the pressures within the cylinder was one of direct experiment in each individual design.

The division of the processes within the cylinder,



such as mixing, ignition and combustion, was assisted by the study of the typical indicator diagram, reproduced in the accompanying engraving. The part B marks the beginning of ignition and C shows where the pressure rise caused by the combustion of the fuel begins. The time interval from B to C is the ignition lag. From C to D combustion is rapid the slope of C D being proportional to the rate at which heat energy is added. For maximum theoretical efficiency C D should approach the vertical, but if D opens too early the loss to the walls was excessive, so that C D must slope towards D. A limit to the steepness of D was imposed by the desirable quality of smooth running, which was of great practical importance, while the ignition lag B C and the rate of pressure rise C D were equally important factors.

In dealing with the experimental work done on ignition lag, reference was made to the original experiments by Professor Hawkes and those by Mr. A. L. Bird, of Cambridge, both of which showed the wide variation in the ignition lag of oils under engine conditions. Both experimenters injected the fuel into air at rest in a vessel. In the course of the discussion, Mr. Bird gave some particulars of later experiments with a moving piston, and it seems that the previous discrepancy found for ignition lag as between vessel experiments and engine conditions is shown to be caused by the air fuel ratio. A strong air blast was, Mr. Bird stated, sufficient to blow out the initial flame. The experiments of Professor Neumann, in which a fan was introduced into the experimental vessel and the lag with and without swirl investigated, were referred to and illustrated. With air at rest the lowest temperature at which combustion took place was 265 deg. Cent., whilst with the air swirl the lowest ignition temperature was 306 deg. Cent. Although these experiments did not repeat the swirl conditions in a high-speed engine cylinder, they showed the definite effect of swirl on ignition lag.

The character of the reactions taking place during the period of ignition lag was next considered and the alternative theories of vaporisation of the fuel and the cracking of the fuel contrasted. The best explanation of what occurs in the light of present knowledge would, the authors suggest, be on the following lines. The oil droplets receive heat from the air during the interval of the ignition lag, and their surface temperature is raised towards that of their ignition point. Oxygen then combines with some of the surface hydrocarbon molecules to form unstable peroxides; these are immediately decomposed, with the evolution of such large amounts of heat that the ignition of the neighbouring hydrocarbon molecules is thus initiated; combustion proceeds subsequently with the rapidity corresponding to these high temperatures. Thus, the interval of time up to the initiation of burning, *i.e.*, the ignition lag, is occupied mainly by the heating of the surface of the droplets, the ignition itself being of extremely short duration.

If this explanation of ignition lag be accepted, then the chief factor would appear to be the rate of heat transfer from the air to the droplets of oil. This question of heat transfer has also been considered by Neumann, and his calculations are both interesting and illuminating. Working back from the quantity of heat necessary to raise unit weight of fuel to the ignition temperature, and using observed values of ignition lag, he calculated the mean coefficients of heat transfer, and obtained the values of the order of one hundred times the normal values for heat transfer from air to ordinary bodies, a fact which leads to the conclusion that chemical reactions, in addition to the mere transfer of heat, must be present. This conclusion is supported by the extremely rapid rise of the coefficient with the air temperature, which is consistent with the direct dependence of the speed of chemical reaction upon temperature. Without specifying the nature of the chemical reactions, these results would seem to indicate that, as seen earlier, evaporation plays at most a minor part in the process; the rate at which heat can be transferred from the air to the oil is the dominant condition. Heat transfer depends upon the difference of temperature between air and fuel, and upon the relative motion of the air and fuel, and if the rate of ordinary heat transfer is increased, then the speeds with which these chemical reactions take place will be proportionately much higher. The latter take place more rapidly, also, the higher the density of the air, a circumstance which explains the lower values of ignition lag in high-compression engines.

Speaking on this section of the paper, Dr. W. R. Ormandy, of the Chemical Engineering Group, referred to ignition lag experiments carried out with an ignition meter of the Constam and Schlapfer type, which showed that there was at first a period of flameless combustion and oxidation during which no amount of movement of particles would hasten combustion. He suggested that a series of experiments on a small variable compression engine on the self-ignition of fuels would be really useful. He reminded those present that all coal oil derivatives possessed difficult physical properties.

In order to compare the cylinder conditions in three very different types of engines the authors reproduced three indicator diagrams due to Professor Neumann for engines of the Deutz direct injection, Junkers opposed-piston, and Koerting ante-chamber types, in which calculated values for temperature and density during compression and curves of ignition temperature had been added. These diagrams showed in a remarkably clear way the injection point, the ignition lag, and the interchange of heat from air to fuel. The values and curve forms vary with the design of engine, and in the Deutz engine, with conditions unfavourable to heat transfer there was a longer ignition lag, while in the other two

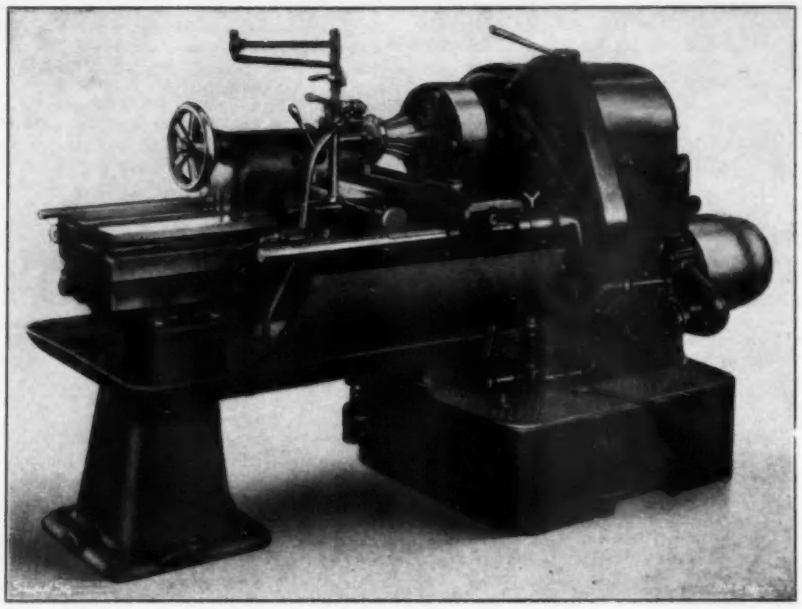
designs the lag was shorter with more favourable heat transfer conditions. The rates of pressure rise are also marked in their difference and vary with engine design. A consideration of the problem of different designs shows that conclusions drawn from one type or size of engine cannot be applied to other types. In the case of an A.E.C.-Acro engine referred to by the authors the effect of speed upon ignition lag is noteworthy. At speeds varying from 700 to 2000 r.p.m. the lag decreases from 14 deg. to 11 deg. of crank angle, or from $^{3}/_{1000}$ second to $^{1}/_{1000}$ of a second. The effect of design on ignition lag was touched upon and the influence of accelerators or dopes referred to, an example of an A.E.C.-Acro engine being given, in which, by using a 5 per cent. addition of ethyl nitrate with an Asiatic fuel, the performance was improved both as regards the maximum pressure, which was lowered from 1100 lb. to 980 lb. per square inch and the reduced rate of pressure rise with much quieter and smoother running. By speeding up the chemical reactions prior to ignition a shorter ignition lag and a satisfactory pressure rise can be attained. In addition to work on engine design, an improved knowledge of fuels, with a wider range of fuels to draw from, would undoubtedly help on the high-speed engine. The present state of our knowledge would be enriched by new work on ignition lag and how this is influenced by the fuel pump and nozzles systems, by the regulated movement of the air, by cylinder design, and by various fuels. Further information on fuels for heavy oil engines providing physical characteristics similar to those given by Ricardo, Tizard, and Pye for petrol engine fuels is also needed.

Subsequent speakers in the discussion threw light on the various aspects of the position above outlined, both in its theoretical and practical sides. Mr. J. F. Alcock, of Ricardo and Co., discussed changes in section on the pipe lines and their effect on the pressure attained, a subject which is dealt with in a paper on "Fuel Systems" by Mr. J. F. Alcock and Mr. H. O. Farmer, which has been presented to the Institution of Mechanical Engineers for written discussion. He agreed with Dr. Ormandy as to the value of self-ignition tests. Mr. L. J. Le Mesurier, of the Institution of Petroleum Technologists, agreed with the authors as to the good workmanship and processes in manufacture which had produced reliable and efficient performance in service, and discussed ignition lag. With regard to fuels, he referred to the paper read by himself and Mr. R. Stansfield before the Institution of Petroleum Technologists, in which tests on fuels for both slow and high-speed engines were included. Mr. Cook, of the Fuel Research Station at Greenwich, spoke on the question of pressure rise and gave some of his own indicator diagrams. On the practical side Mr. W. A. Tookey said that he found himself somewhat distrustful of experiments produced under the "static" conditions of a university laboratory and relied more on the test bed and shop experience. This remark drew from Dr. Davies the reply that all the experiments referred to had been carried out by engineers and that laboratory conditions were nowadays "dynamic." Mr. Tookey further instanced the work of the early gas engine designers and the high compression ignition ratios of 3·6 to 4 typical of gas engine practice, compared with the 1·5 figure of the oil engine, and advocated higher ignition pressures. Mr. R. Strube, of W. H. Allen, Sons and Co., Ltd., of Bedford, held the view that laboratory experiments of the type described were most valuable and that a thorough knowledge of the scientific principles of design often made a difference of months in the bringing out of a new type of engine. On the aeronautical side Major G. P. Bulman referred to the tests with accelerators or dopes made by Flight-Lieutenant Simms and Squadron-Leader Helmore and the interest taken in the high-speed oil engine for aircraft. Quite recently the Junkers heavy oil aero-engine had successfully passed a fifty-hour type test. It had an output of 720 B.H.P. and weighed 1800 lb. and the fuel consumption was 0·37 lb. per B.H.P. hour with 0·03 lb. of lubricating oil per B.H.P. hour, making a total of 0·4 lb. The tests had been carried out at altitudes of over 20,000ft. under low-temperature conditions. The heavy-oil aero-engine was, he held, now in sight. Similar tests with the American Packard Diesel engine had not, however, been so successful. Other speakers dealt with the necessity for standard fuel pump tests and the influence of pipe design and material on pump performance. Mr. Alan E. L. Chorlton referred to his own work on high-speed oil engines, and suggested that pilot ignition might be tried with different fuels. Wing-Commander Cave-Brown-Cave made the suggestion that at light loads especially, pre-heated induction air might be tried with advantage. The suggestion of the authors of the paper that, in view of the valuable results obtained by the Marine Oil Engine Trials Committee with large oil engines, a similar co-operative action by manufacturers and technical institutions to advance the development of the high-speed heavy oil engine should be brought about is a valuable one, which should be carefully considered by all those interested in this new and growing branch of the British oil engine industry.

We understand that the paper, with an extended bibliography, the full discussion, and the authors' replies will be reprinted in book form in Vol. XXV. of the "Proceedings" of the Institution of Automobile Engineers later in the year.

ELECTRICALLY-DRIVEN TOOL-ROOM LATHE

DEAN, SMITH AND GRACE, LTD., KEIGHLEY, ENGINEERS



Relieving Attachment for Tool-room Lathe.

At the Machine Tool Exhibition, held at Olympia in September, 1928, Dean, Smith and Grace, Ltd., of Keighley, showed a 7in. toolroom lathe fitted with a self-contained electric motor drive. We described and illustrated this machine in our issue of September 28th, 1928. As exhibited the machine was equipped with a taper turning attachment and in our article it was mentioned that, in addition, it could be fitted with a relieving movement to the tool rest, whereby a varying number of flutes from two upwards could be relieved. We are now in a position to describe the relieving mechanism in detail and to refer to a particularly severe test of it and the machine generally which the makers have recently carried out.

A rear view of the lathe at work relieving a form milling cutter is given above, and in Fig. 1 the tapering and relieving mechanism is illustrated. The bracket A, Fig. 1, bolted to the back of the saddle supports a slide B, which is held against movement by the screw C and the bracket D. The slide B carries a bar E, which can be adjusted and locked, over a range of inclination, on the slide B. The bar E engages with a block F attached to the bottom slide G of the saddle. This mechanism is employed for ordinary taper turning and also when it is required to give relief to a tapered body.

The relieving motion is communicated to the tool through a cam situated within the bottom slide of the saddle coaxially with the centre about which the top slide H swivels. This cam is mounted on a square stud and by lifting off the slide H the cam is exposed and can be replaced by one of a different throw. The cam is driven by a shaft in the saddle, which in turn is driven through spiral gearing from the shaft I carried in the bracket A. The shaft I is driven at the requisite speed to suit the number of flutes to be relieved by means of change wheels on the swinging plate K. The gear wheels on this plate derive their motion from a wheel in the headstock running at five times the spindle speed. Inside the headstock there is a sliding gear wheel which is used to disconnect the relieving motion when it is not required. The shaft I is driven through a clutch Y in the view above, which drives in one direction only, and which provides for safety in the event of the rotation of the spindle being reversed while the relieving motion is in action. For roughly adjusting the position of the tool to suit the diameter of the work a nut is provided under the cover L on the slide. By means of a square-headed screw at M the cam motion can be held out of operation as is useful when the slide is being removed, for the purpose of changing the cams.

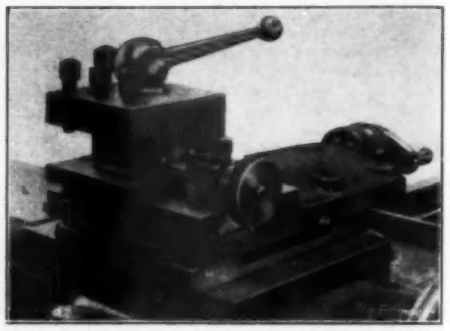


FIG. 2—FINE ADJUSTMENT TOOL HOLDER

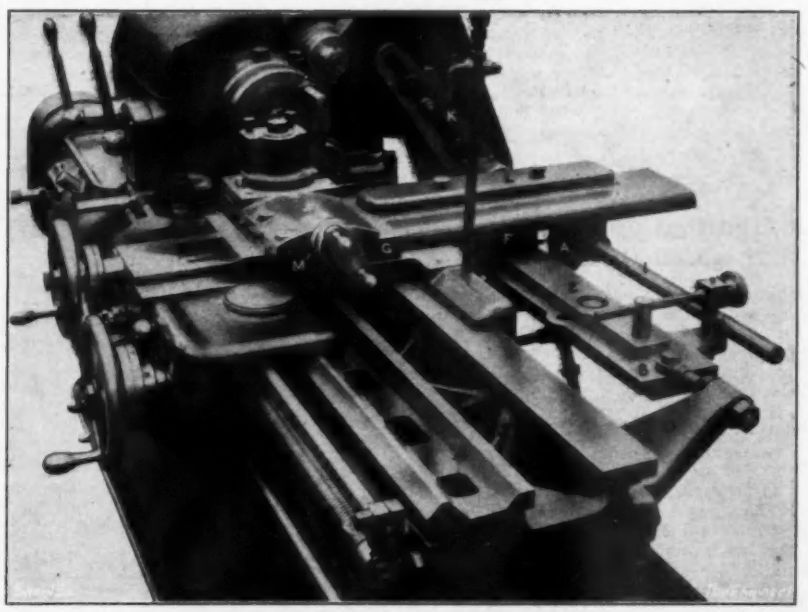


FIG. 1—TAPERING AND RELIEVING MECHANISM

The tool holder shown in Fig. 1 is a swivelling holder which is used for ordinary turning. For relieving purposes it is replaced by the fine-adjustment tool holder shown in

Fig. 2. In this view the tool rest is shown as set for relieving teeth on the ends or faces of cutters. For relieving over the diameters of taps, hobs and similar cutters the tool rest is swivelled through 90 deg. from the position shown in Fig. 2. The tapering attachment can be used in conjunction with the relieving mechanism for relieving tapered cutters. By means of the sliding gear wheel in the headstock, whereby the relieving mechanism is brought into action or disengaged, the work can very readily be set to coincide with the stroke of the cam. This arrangement avoids the difficulties involved in the usual method, in which repeated trial adjustments of the work are made until it times with the cam. The makers call attention to the fact that the relieving mechanism does not contain any universal joints, sliding pins or levers or other parts liable to work loose under the constant jarring which accompanies relieving.

The lathe is a tool-room or precision machine and was not designed purely as a relieving lathe. As, however, it

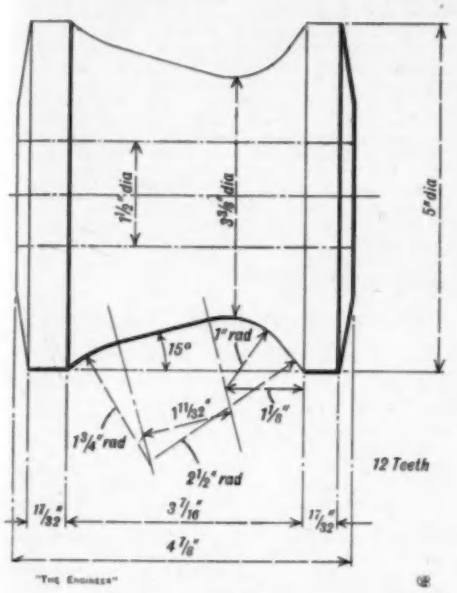


FIG. 3—FORM CUTTER

possessed a relieving attachment, the makers recently put it into service as a production lathe for the turning and relieving of the twelve-tooth form cutter illustrated in Fig. 3. For the relief of the straight portions of the teeth the tapering attachment was used. For the curved portions formed tools were employed. The time for relieving one of these cutters was 4½ hours.

The Present Position of the Diesel Engine for Marine Purposes.*

By Dr. H. H. BLACHE.

THE present position of the marine Diesel engine has not yet resulted in a uniform design. The construction has been left in the hands of comparatively few leading manufacturers, each creating his own particular type.

The lower structures of all marine Diesel engines are now very similar in design. Forced lubrication and enclosed crank casings have been adopted throughout. The A frames with through stay bolts, introduced by Messrs. Burmeister and Wain in 1913 are now being employed in most marine engines. The mode of procedure in attaching the bed-plate to the double bottom has been much discussed. The flat-bottomed bed-plate bolted direct to the tank top is preferred by shipbuilders, owing to the simple and cheap construction of the hull.

FOUR-STROKE ENGINES.

The modern four-stroke engine has made progress by the introduction of "high-pressure induction," *i.e.*, admitting the inlet air under a pressure of from 4 lb. to 5 lb. per square inch.

Admitting inlet air to internal combustion engines at a pressure has been known for a considerable time, and the patent rights underlying this principle were acquired as early as 1905. At present sixty-four motor ships fitted with the B. & W. type of engine are provided with low-pressure induction air and electrically driven blowers. The late Professor Rateau, the pioneer designer of turbo-blowers, was the first to introduce high-pressure induction air and exhaust turbo-blowers in connection with internal combustion engines, the first of these blowers being utilised for aeroplane motors. The Swiss engineer, Mr. Büchi, co-operating with Brown, Boveri et Cie., the well-known builders of rotary blowers, has worked very energetically for the introduction of high-pressure induction and exhaust-driven turbo-blowers on Diesel engines. Burmeister and Wain have fitted a number of engines with the Rateau type of blower, and their licensees, Harland and Wolff, have turned out a number of installations fitted with Büchi type blowers.

The motive power of the exhaust turbo-blowers is derived from the energy created in the pressure period at the opening of each cylinder's exhaust valve. From the weak spring indicator cars taken during the trials of supercharged engines, it was found that the pressure wave in the exhaust piping was extended by passing the turbine nozzles, thereby increasing the back pressure in the cylinders of the Diesel engine, incurring a loss in indicated mean pressure. This observation resulted in the design of the B. & W. high-pressure air induction system with chain-driven, rotary blower, the same type as adopted for the B. & W. two-stroke type.

Fig. 1 represents a weak spring indicator card from an engine fitted with the Rateau type of exhaust turbo-blower, and Fig. 2 the weak spring card from an engine fitted with the B. & W. type of chain-driven rotary blower. The dimensions of the engines are the same, both having eight cylinders, 740 mm. diameter, with a stroke of 1500 mm., and running at 110 revolutions.

The mean pressure of the engine with exhaust blowers being 8·47 kilos. per square centimetre = 5342 I.H.P. = 4407 B.H.P., and corrected for the mean pressure of the weak spring card, m.p. = 0·32 kilos. per square centi-

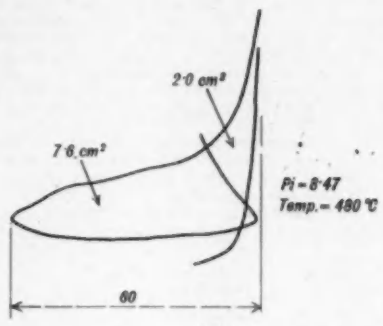


FIG. 1.

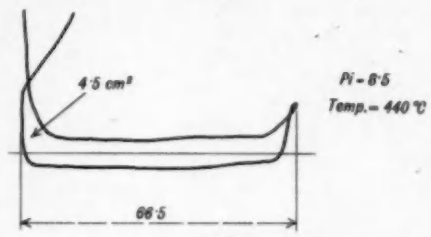


FIG. 2.

FIGS. 1 AND 2—WEAK SPRING DIAGRAMS

metre. The I.H.P. would be 5140 and the difference 202 H.P.

The mean pressure of the engine with the B. & W. system of chain-driven blowers being 8·5 kilos. per square centimetre = 5361 I.H.P. = 4369 B.H.P., corrected for the weak spring card, m.p. = 0·135 kilos. per square centimetre, the I.H.P. would be 5276 and the difference 85 H.P.

It is apparent that the difference between I.H.P. and B.H.P. for the engine with exhaust blower is 202 H.P., whilst for the B. & W. system it is 85 H.P., giving 117 H.P. in favour of the latter type.

The output of the rotary blower is 170 cubic metres per minute, and the power necessary to drive the blower at a

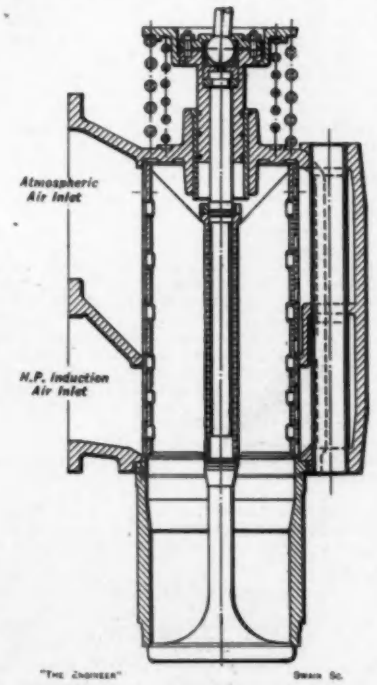


FIG. 3—SECTION THROUGH INLET VALVE

pressure of 5·2 lb. per square inch = 160 H.P., which, compared with the 117 H.P. gained by the less resistance in the exhaust pressure of the B. & W. system, means a loss of 43 H.P., or less than 1 per cent., and is therefore of little importance.

Further, as the engine of the B. & W. high-pressure induction air system is exhausting to the atmosphere without any resistance, a most effective scavenging of the compression space is attained, as can be seen from the top end of the weak spring card—Fig. 2.

The B. & W. type of pressure induction four-stroke Diesel engine embodies a special design of the inlet valve. This valve and its casing—shown in Fig. 3—is provided with a multi-ported piston valve, one branch for pressure air and one for the atmospheric air. The cylinders are filled with atmospheric air in the usual way during the principal part of the stroke, through ports open to the atmospheric air; but during the closing period and the opening period of the inlet valve the high-pressure induction air is admitted—as shown in Fig. 4—whereby the cylinders are filled by the pressure induction at the bottom of the stroke, and the compression space scavenged at the top of the stroke. The volume of air which the blower needs to produce amounts to about 60 per cent. of the "swept" cylinder volume, whilst the air for the ordinary pressure induction equals about 130 per cent. of the cylinder volume. The blower is designed on the rotary principle.

Particulars are given below for two sets of ten-cylinder trunk-piston engines fitted with the same type of pressure air induction. The engines are to be installed in the Bergenske Dampskibsselskabs new passenger vessel "Venus," intended for the company's mail service between Bergen and Newcastle.

Horse-power of two main engines	10,000 B.H.P.
Weight, including thrust, shaft and thrust block	645 tons
Weight per B.H.P.	144 lb.
Total weight of machinery, including water and lubricating oil	1,100 tons
Weight per B.H.P.	243 lb.
The height from base line to deck above the main engines measures	32ft.

The Burmeister and Wain four-stroke, double-acting type of Diesel engine is fitted in twenty-six passenger vessels in service, the most prominent being the White Star liner "Britannic," built and engined by Messrs. Harland and Wolff. The main engines aggregate a total of 20,000 H.P. Two additional sets of this type are under construction, whilst twelve ships fitted with the double-acting, four-stroke Werkspoor engine are in service.

TWO-STROKE ENGINES.

The different types of the two-stroke Diesel engine can best be characterised by the various methods adopted in scavenging the cylinders.

The "non-complicated" two-stroke type is provided with exhaust as well as scavenging ports, controlled by the main piston, as known from the ordinary two-stroke, hot-bulb engine. This type has not been largely adopted, though its simple design should be an advantage.

As the scavenging and exhaust are controlled by the piston, the scavenging ports will be closed prior to the exhaust ports. Pressure waves in the exhaust piping can accordingly blow back through the open exhaust ports, and further reduce the amount of fresh air left in the cylinder after the scavenging, which is not fully clean, owing to the tendency of air and gases to form eddying currents during the scavenging period.

The M.A.N. company construct its well-known double-acting type of two-stroke engine, having the scavenging and exhaust ports placed above each other on the same side of the cylinder. The improved scavenging of the cylinder thus obtained is in the same way subject to pollution from the exhaust gases, due to the exhaust ports being full open when the scavenging ports are closed.

The introduction of a rotary piston valve in the exhaust port was experimentally tried by B. & W. with fairly good

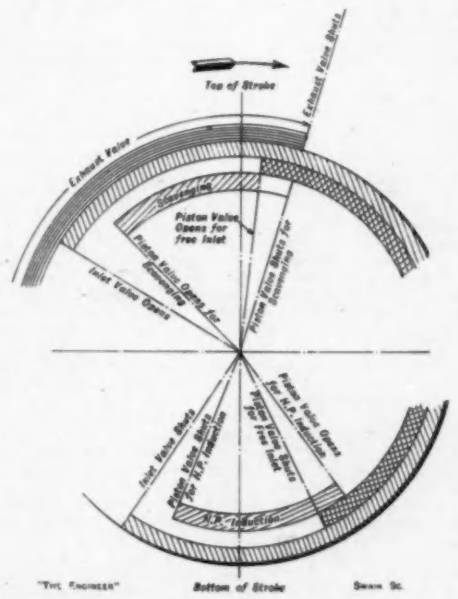


FIG. 4—FOUR-STROKE VALVE TIMING DIAGRAM.

results on an engine of the "non-complicated" type in 1922, and is utilised practically by Scotts Shipbuilding and Engineering Company, Ltd., of Greenock, on their single-acting, two-stroke engine to prevent exhaust from blowing back into the cylinders. Engines fitted with this gear must be classed amongst the two-stroke engines, which are of the "complicated" type, designed in order to get a complete and clean scavenging of the cylinders. The Doxford "opposed-piston engine" belongs to this class. The good scavenging is obtained by letting the gases and air flow through a long cylinder in the same direction. The Sulzer engine is fitted with automatic valves to admit clean scavenging air to the cylinders after the exhaust ports are closed.

The B. & W. two-stroke engine may be referred to the same category. The first of this type was constructed for the motor ship "Amerika," built to the order of the East Asiatic Company, Ltd., and put into service December, 1929.

In this engine the scavenging ports are arranged around the whole circumference of the cylinder. The exhaust ports are located centrally in the top and bottom cover, and controlled by piston valves, rigidly connected to each

* Institution of Naval Architects, March 27th, 1931. Abridged.

other, operated by a completely enclosed forced lubricated gear and chain-driven crank shaft inside the crank casing.

The motion of the exhaust piston valve is in advance of the main crank shaft, whereby the exhaust ports are opened before the scavenging ports are opened by the piston, and closed before the scavenging ports are closed—see Fig. 5. The scavenging takes place through the cylinder in one direction, and the exhaust is fully prevented from flowing back. Owing to the early closing of the exhaust piston valve a recharge of fresh air takes place, thus obtaining a

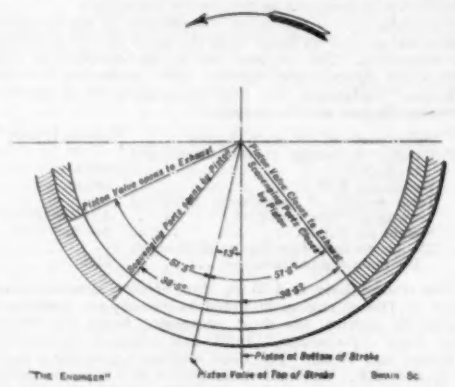


FIG. 5—TWO-STROKE SCAVENGING DIAGRAM

smokeless combustion by mechanical injection up to an indicated mean pressure of 120 lb. per square inch.

From the indicator cards of the main cylinder and the exhaust piston valve, it has been shown that the card from the piston valve is a very full one with a high mean pressure, indicating that the piston valve develops a certain amount of useful work, which represents an increase in horse-power of the engine of about 10 per cent.

Airless Injection.

The design of fuel pumps and valves is in detail rather different, but the principle adopted for the airless injection is practically the same. The atomising takes place through small sprayer holes about 0·5 mm. to 0·9 mm. diameter under a pressure of from 7000 lb. to 8000 lb. per square inch on the fuel oil. The fuel pump, fuel valve and fuel pipe joints must be of high-class workmanship. Compared to air injection it is a simplification, as the air compressor, high-pressure air piping, and air bottles are eliminated, with a corresponding gain of space, less weight, and a reduction of about 6 per cent. in the fuel consumption per B.H.P.

The adjustment of the airless injection engines for each various cylinder dimension entails additional work and longer time on the test-bed than the air injection type.

Clean air is essential to obtain a smokeless combustion with airless injection, and the four-stroke Diesel engine fitted with pressure induction is, therefore, better adapted for airless injection than the ordinary four-stroke engine. In the same way the "complicated" two-stroke engine is better than the "non-complicated" type.

Of great importance in the utilisation of airless injection for marine purposes is its adaptability for the different qualities of fuel oil as supplied to motor ships in service all over the world. This can only be fully ascertained in actual service.

Utilisation of Heat from Exhaust Gases.

The heat from the exhaust gases of four-stroke as well as two-stroke engines can be utilised to advantage in practically all types of boilers, the pioneer of these being the Clarkson type. On account of the contraction of the gases when cooled down, no back pressure will be set up, and the exhaust gases are perfectly silenced, so that no silencer behind the boiler is necessary.

The use of exhaust boilers is particularly advantageous for the heating, cooking and hot-water service in passenger vessels, and from results of such ships in the North Sea trade it is found that a saving of about 7 per cent. in fuel oil consumption can be attained.

In tankers, where cargo winches are unnecessary, the exhaust boilers can eliminate the Diesel generators, as all pumps for the service at sea can be worked from the main engines, and under ordinary sea conditions the necessary amount of steam can be supplied by the exhaust boilers for the steering engine, a small steam dynamo, heating, &c.

Vibration.

A few cases of vibration in hull and engines of Diesel passenger ships have been the means of spreading the rumour that Diesel motor ships always vibrate strongly, though previously similar cases for steamers have passed unnoticed.

The emphatic assertions regarding vibration in Diesel-engined passenger ships has furthered the study of minimising vibration. In recent years the problem has been treated scientifically, and the results checked by instruments of the seismograph type, whereby the coefficients found by experience and necessary for the calculations have been verified.

It is now possible to calculate beforehand all relations regarding vibration, and determine positively in advance the critical number of revolutions, and thus avoid those which are liable to set up vibrations on different parts of the hull. Motor passenger ships can, therefore, to-day, be designed so that they are in no respect inferior to steam-driven vessels as regards vibration.

Diesel Engines for Warships.

Diesel machinery will, undoubtedly, in the future, be adopted for light cruisers operating long distances from their base. The new German cruiser "Ersatz Preussen" is the first of this type. The single-acting, two-stroke trunk engine is particularly suitable for this purpose, and Burmeister and Wain are at present constructing a small plant of this type of engine aggregating 2200 B.H.P., for a single-screw passenger ship, but this is only a modest start, and engines of the same type can to-day be constructed up to 10,000 B.H.P. per unit. The revolutions about 350 per minute and the weight, including thrust-block, about 36 lb. per B.H.P.

Tramps and Cargo Liners.

The most important vessels are undoubtedly the ordinary tramp and the cargo liner.

When trade is poor and freights low, the ship best able to conquer in the competition is one that with the same principal dimensions has the largest cubic capacity, largest deadweight capacity, highest speed, and the most economical cargo-handling facilities. This is undoubtedly the Diesel-engined ship. A proof of this is found in the number of orders placed by leading Scandinavian shipowners in recent years, viz.:—The East Asiatic Company, 26 ships; Wilh. Wilhelmsen, 34 ships; Fred Olsen, 21 ships; A/B Brostroms Linieagentur, 27 ships.

It is worth noticing that the speed of motor ships has increased year by year, the reason being their small fuel consumption and small engine-room space, allowing engines of high horse-power to be installed without reducing the cargo space and the deadweight capacity correspondingly, thus enabling the owner to obtain high rates, and the ship to perform more trips per year, thereby increasing the earning capacity of the vessel.

Scandinavian shipowners have furnished some information regarding the maintenance costs for motor ships over a number of years, which is given in the paper.

Table I. shows the expenditure on the upkeep and running of the engines for three different classes of motor ships belonging to one of the largest Danish shipping companies.

Table I.—*Working and Maintenance Cost as Given by One of the Largest Danish Companies, Four Years' Average, 1926-1929.*

	Cargo ship, about 10,000 tons deadweight	Passenger ship.	Coasting vessel, about 600 tons deadweight
Ships' displacement	12,050	3,060	950
Number of days in commission	360	345	344
Total mileage	43,820	51,125	26,600
I.H.P.	2,800	4,200	750
Consumption of fuel oil, in tons	1,780	2,160	250
Expenses for upkeep, in £			
Main engines with auxiliary machinery	258	238	127
Propellers and shafting	31·6	51·6	8·0
Ships' auxiliary machinery	388	229	86·2
Winches	63·2	17·3	30·8
Working expenses, excluding fuel oil, £	431	493	115·4
Total expenses, excluding fuel oil, £	1,171·8	1,028·9	367·4

In comparing these expenses with those corresponding for steamers, it should be remembered that the maintenance costs of the hull for motor ships are less than for steamers, owing to the corrosion of a steamship's plating being always found in way of steam-pipes, around steam winches, in the coal bunkers, and under the boilers.

In Britain steam is still favoured, owing to the country's richness in coal and the number of people whose existence depends on coal production.

It is natural that all progress in the higher economy of coal consumption and the easier handling of the coal which add to the competitive power of the coal-fired steamers as against the Diesel-engined ships, should be viewed with the greatest interest in a coal-producing country, but I cannot understand why the advocates of steam generated by oil seem to be equally favoured.

Great efforts have been made in recent years to improve the economy of the oil-fired steam plants from about 0·93 lb. to 0·65 lb. per B.H.P. for the steam-driven plants of fast-running passenger liners, and the leading steam engineers expect a further reduction to about 0·56 lb., but even the latter figure is about 50 per cent. higher than that for corresponding marine Diesel plants.

The higher initial cost of the Diesel machinery in relation to the steam plant, the interest thereon and the depreciation, have been referred to in many papers on steam *versus* Diesel. I believe that the latest development of the marine Diesel engine and the steam-engine plant with regard to price will prove to be in favour of the former. I do not intend to give any comparative prices of steam and Diesel engines, as the way to ascertain these is by comparing the tenders when new tonnage is to be ordered, but I wish to direct the attention to a fact in favour of the Diesel engine. Should the initial cost of the Diesel plant be the highest, the difference means in these days of unemployment more work for the shipbuilding countries, whilst, on the other hand, oil-fired steam plants in service entail wasting fuel oil, which is only remunerative to the oil-producing countries. In conclusion, I wish to say that at the present stage of the marine Diesel engine, it is adaptable for all types of ships from a 35 H.P. engine, such as is used in fishing craft to a 20,000 H.P. plant, as installed in the ms. "Britannic." In fact, the Diesel engine should be adopted when burning oil, and the steam engine when burning coal.

SIXTY YEARS AGO.

To the modern reader there is a touch almost of the archaic about a leading article on steam launches which appeared in our issue of April 14th, 1871. The term "steam launch" was still sufficiently novel to be printed between inverted commas and to require definition as meaning a pleasure boat impelled by steam. We had followed the recent Oxford and Cambridge boat race in a steam launch that had been placed at our disposal and returned greatly impressed with its comfort and capabilities. From what we had seen on the river we were convinced that steam launches were growing in popularity. We were satisfied that that popularity was well grounded and that it had nothing in common with the "velocipede mania" of 1869. Steam launches had been vilified and abused. They had been described as floating steam kettles, and it had been alleged that they were inimical to rowing and that they would ruin the river. Nevertheless, they were obviously increasing in number. Not a few men with villas at Twickenham or Richmond, so we wrote, regarded a steam launch as being as essential to the completeness of their establishments as a brougham or a pony phaeton. All things considered, we came to the conclusion that the construction of steam launches was rapidly becoming a distinct branch of engineering, and that it was a branch to which engineers might worthily devote their attention. It was not to be supposed, we said, that the use of the little steamers was confined to the Thames. Inland voyages of marvellous extent could be made in them on our canal systems, and in calm summer weather the larger and better-built boats of the type might even accomplish sea voyages of no trifling kind. A run from Greenock to Arran and Cantyre had been made before now in a very small craft driven by a steam engine, which four men could carry away complete, boiler and all, with ease. We had a few criticisms and a few suggestions to make concerning the design of steam launches and their engines. Our chief concern lay with the screw. It was essential that the screw should have a "good grip" on the water right from the starting of the engines, for, above all things, a steam launch had to be handy and had to answer her helm as promptly as a well-broken horse answered the pressure of his rider's knees. In addition, the propeller had to be so designed that it would not become readily fouled with weeds. We had been much impressed by the means adopted to that end in the launch on which we had followed the boat race. Each blade of the screw had been furnished with a sharp steel knife and a stationary knife had been fixed to the stern-post. We described the arrangement as resembling a chaff-cutter and as one which nothing much short of an old basket would foul. It is a remarkable and gratifying fact that the man who built the launch on which we journeyed up the Thames that day sixty years ago is still with us. It had been constructed by Yarrow and Hedley, of the Isle of Dogs.

A Visit to William Beardmore and Co., Ltd.

On Tuesday, March 31st, William Beardmore and Co., Ltd., received a visit from a number of representatives of the Technical Press at their Parkhead Works, in Glasgow. The notice of the visitors was directed particularly to the high-speed oil engine department, and arrangements had been made for a number of engines to be running in the testing shops. After the visit to the works themselves an informal and interesting discussion took place, and was continued during the luncheon which followed. While passing to and from the test bay through the shops it was noticed that a considerable amount of work was being done in connection with the installation of new tools and equipment, and a large machine shop which is now being fitted up will soon be available for production.

The development of a high-speed oil engine has been made possible by the design of a fuel pump which is capable of delivering a positively measured amount of fuel oil under all conditions of running. The "Beardmore" fuel injection system achieves this object by the use of a piston valve on the suction side of the pump, designed in the form of a helix, the rotation of which varies the period of injection of the fuel to the atomisers and by a differential movement in the direction of its stroke varies the time of injection relative to the position of the crank shaft. This fuel injection system was first used on a "V" type twin-cylinder engine, 17in. bore by 20in. stroke, developing 430 B.H.P. at 450 r.p.m., which was constructed for the Admiralty with a view to its use for the propulsion of submarines. The trials of the engine were successful, and although it was developed no further by the Admiralty, the fuel injection system proved its worth sufficiently to be incorporated in engines adapted for use in aircraft, tanks, locomotives, and generating sets.

In 1924 the firm, in conjunction with the Air Ministry, started to develop a high-speed oil engine suitable for use in airships, and in 1926 production of these was begun for the airship "R 101." For these engines mild steel was used in many places where aluminium had previously been employed, and the casting of sections as thin as ⅛ in. in steel was developed at the firm's own foundry.

It will be remembered that the engines of the "R 101" were to have been fitted with variable pitch propellers, but it was found impossible to produce propellers of this type strong enough. In consequence, Beardmore's set about designing a reversible engine, and two of these were fitted to the airship in 1930.

The firm has also developed engines for railway traction purposes, and a number have been supplied to the Canadian National Railways, on which they have performed very successfully. A four-cylinder 8½in. by 12in. engine, running at 750 r.p.m. and giving 200 B.H.P., installed in a rail car, was given a very severe test. It ran from Montreal to Vancouver non-stop. The distance of over 2300 miles was covered in sixty-eight hours.

It is impossible within the limits of this article to describe all the interesting engines that were seen running in the test bays, but one or two call for special mention. The firm is using a four-cylinder horizontally opposed type engine, 7in. by 8in., running at 1200 r.p.m. for a power of 150 B.H.P., for research work in connection with the development of an engine suitable for aeroplanes. It was pointed out that such an engine would be very suitable for installing in the wings of the aircraft, and that even when not so installed the head resistance was very small.

In the aero-engine test shop the Tornado Mk. III. A.R. engine was to be seen. This engine is an improvement on those that were fitted in the "R 101." It is reversible, and by careful design it has been made lighter by about 600 lb., so that its weight is now 4000 lb. It is hoped that if the attitude of the Government towards the development of airships is benevolent it will be possible to produce an engine weighing 4½ lb. per B.H.P. against the present weight of 7·8 lb. per B.H.P. Taking into consideration the present weight of the engine and the fuel carried for a flight of seventy-two hours' duration, a ship of the capacity of the "R 101" could be fitted with engines with a saving in weight of 2 tons over that for a similar ship fitted with petrol engines for the same flight duration. The engine has eight cylinders, 8½in. by 12in., develops a B.H.P. of 585, and runs at 900 r.p.m.

Among the other engines seen were one of four cylinders for a commercial vehicle, and a 100 B.H.P. engine with the same number of cylinders for use with a generator.

A New Wireless System.

A SOMEWHAT remarkable wireless telephone demonstration was given on Tuesday, March 31st, by the International Telephone and Telegraph laboratories of Hendon, London, in co-operation with the laboratories of Le Matériel Téléphonique, of Paris. By means of a new wireless telephone and telegraph equipment, largely developed by French engineers, in the Paris laboratories, two-way telephone communication was established between Dover and Calais, on a wave length as low as 18 cm. While experimenters have, of course, previously succeeded in generating and utilising wave lengths of this nature, prior to the establishment of this wireless circuit between Dover and Calais, the investigations have been confined to the laboratory. The demonstration indicated, however, that a very marked advance has been made in the utilisation of these short waves for communication purposes, and that the range of wave lengths between 10 cm. and 100 cm. is now ripe for commercial use. The quality of the speech on the occasion of the demonstration left little, if anything, to be desired, and showed no signs of being affected by fading. These extremely short wave lengths permit of the use of reflectors resembling those used for the reflection of light, and very small antennæ systems. Although fog, rain and other climatic effects, as well as day and night effects, do not materially interfere with the propagation of the waves, conductive obstacles of too great a length must not be interposed between the transmitter and receiver. For a clear stretch such as that between Dover and Calais, however, the system is readily applicable.

The demonstration took place on the cliffs of St. Margaret's Bay, near Dover, where the transmitter and receiver have been erected, the transmitter and receiver across the Channel at Blanc Nez, near Calais, being practically identical with these on this side of the Channel. The outgoing signals are applied to a "micro-radion" tube—see Fig. 1—in which the high-frequency oscillations are generated, and a short conductor connects the tube to the radiating system or doublet, which is only 2 cm. long and which is situated at the focus of a paraboloidal reflector, some 3 m. in diameter. This serves to concentrate the radiated waves in a small solid angle accurately directed towards the distant receiver. In this reflector the relation between the focal length and diameter is so proportioned as to ensure maximum efficiency for the diameter used, and, in order still further to increase the efficiency of the system by the prevention of radiation other than in the required direction, a hemi-spherical reflector is placed at the opposite side of the doublet to the paraboloidal reflector, and having the doublet at the centre, this serving to collect all the radiation propagated in a forward direction, and to reflect it back again towards the source. The radius of the hemi-spherical reflector is so chosen that when the reflected radiations reach the focus again, they are in phase with those being radiated at that instant. The appropriate length of the radius depends upon the wave length, the relation being that it should be substantially a multiple of half-wave lengths, *i.e.*, radius $= N \frac{\lambda}{2}$, the factor N being so chosen that the radius shall be large enough to ensure that the reflector has satisfactory electro-optical properties, but is not so large as unduly to intercept the radiations reflected forward from the paraboloidal reflector. The function of the spherical reflector is shown in Fig. 2, where the effect of diffraction is neglected, although, in practice, it must be taken into consideration. The direct radiations, such as A B, pass straight to the paraboloidal reflector and are diverted towards the distant receiver, whilst waves, such as A, C, are reflected by the hemi-spherical mirror back through A on to the paraboloidal mirror at D and so out in the required direction.

Another interesting feature of the apparatus is the instrument used for measuring the high-frequency output of the transmitter. An aperture in the paraboloidal reflector allows part of the radiation to pass through this reflector, but, by making the diameter of the aperture slightly smaller than that of the hemi-spherical reflector, no loss of radiated power occurs. The radiations passing through the aperture fall upon the special measuring instrument, shown in Fig. 3, which takes the form of a wave meter calibrated for, and normally set to, the transmitted frequency. It comprises a small receiving antenna and the E.M.F. induced in it acts upon a thermo-couple junction. The readings of the galvanometer are an indication of the power radiated, whilst, as the distance between the antenna and metal screen is adjustable, the instrument may also be used for measuring wave length. As we have said during the demonstration the wave length used was 18 cm., while the power radiated was in the neighbourhood of 0·5 watt.

The party invited to witness the demonstration was conveyed from Dover Station to St. Margaret's Bay in motor coaches, which were equipped with headphones, and when the coaches arrived at their destination, the headphones were connected up to the wireless apparatus. In turn, each member of the party was handed an ordinary telephone instrument and had an opportunity of speaking to Calais, while the others listened to the two-way conversation. The demonstration was admirably organised, and it proved highly interesting and instructive. Apart from the fact that the wireless receiver is not provided with a frequency-measuring device, it is practically the same as the transmitter, and comprises a doublet, connected to "micro-radion" tube, which, of course, serves as a detector. In order to avoid coupling, the receiver is placed about 80 yards from the transmitter, both at Dover and at Calais, the receiver at Dover being shown on the right of Fig. 4 and also separately in Fig. 5. The same wave length is used both for sending and receiving.

Experiments with the new apparatus have clearly shown that a wave length range of from 10 cm. to 100 cm. is now available, the frequency range within this band being some nine times as great as that hitherto used in wireless work. The importance of the scheme from the point of view of overcoming the ether congestion trouble is, therefore, obvious. Another noteworthy feature is that the radiations can readily be concentrated into a small solid angle at small expense.

Although, as already explained, large conducting objects in the path of the beam are not permissible, this will not prevent long-distance working; in fact, it is contended that there are commercial applications in a wide world communication network like the international system. The frequency band available will allow of a very large number of permanent and continuous channels between the same places without mutual interference, while the directional properties of the waves will make it possible to use the same frequencies over other routes. It is also claimed that the system will prove of great value in connection with television which is at present hampered by the very large frequency range required for the satisfactory definition of the object transmitted.

Moreover, for navigation purposes, and especially for radio beacons, the simplicity of the transmitters is an obvious advantage.

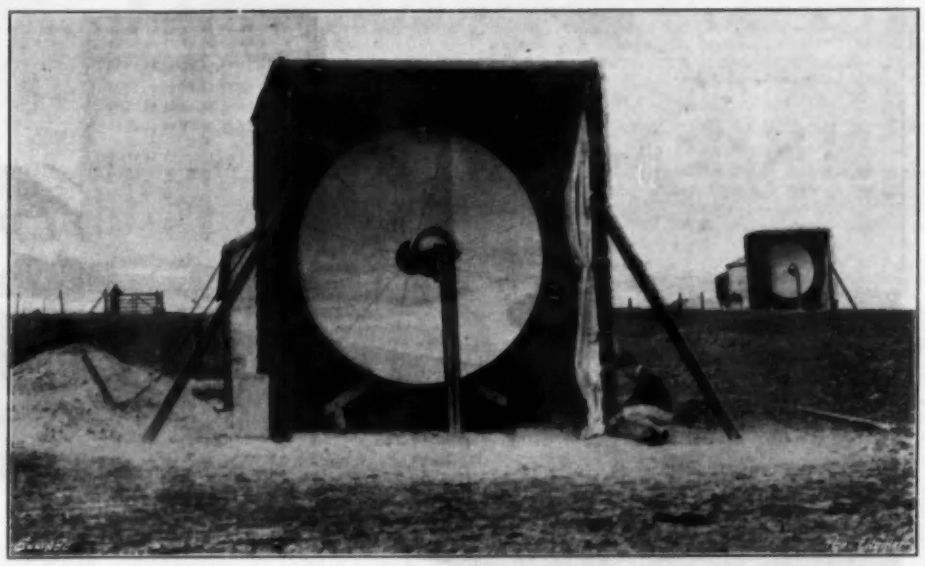
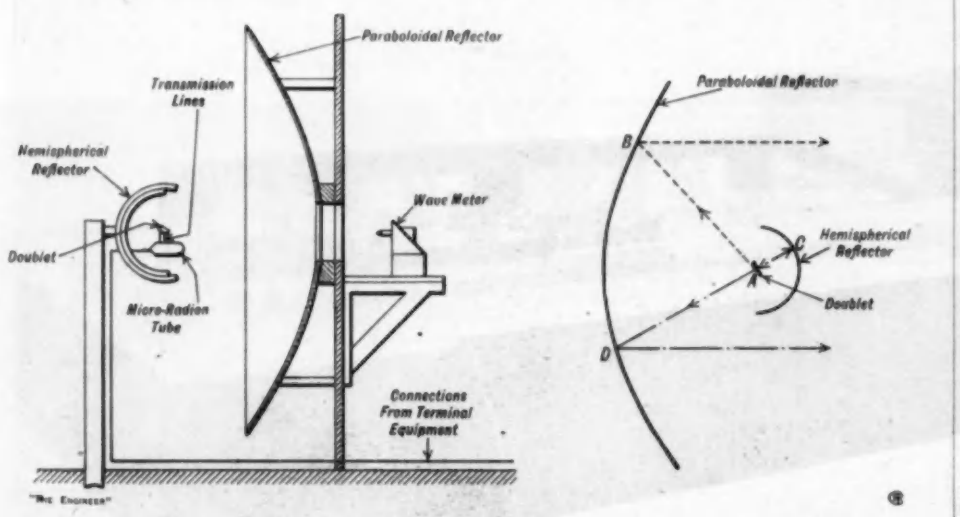


FIG. 4—TRANSMITTER AND RECEIVER



FIGS. 1 AND 2—DETAILS OF TRANSMITTER

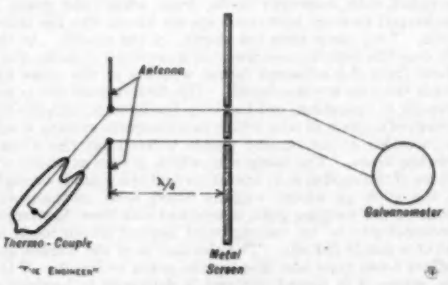


FIG. 3—WAVE METER

FIG. 5—RECEIVER

Letters to the Editor.

We do not hold ourselves responsible for the opinions of our correspondents.)

GOLD IN ITS RELATION TO INDUSTRIAL PROSPERITY.

SIR,—The warning given by Mr. C. H. Douglas in your issue of March 20th appears to be a timely one. It is difficult to read the essays of bankers and economists on the stabilisation of prices without a horrible feeling that there is something fundamentally wrong with their ideas of stable equilibrium and the forces tending towards it; and the fact that the idea of price stabilising by the sterilisation of gold stocks seems to have emanated from America, where the gold stocks are notoriously large, does not relieve it.

Adjustments to make the gold standard work appear more like adjustments to avoid the economic consequences of its natural operation. The system is artificial, and how many times have artificial arrangements lasted? It is significant that not all bankers are agreed upon it.

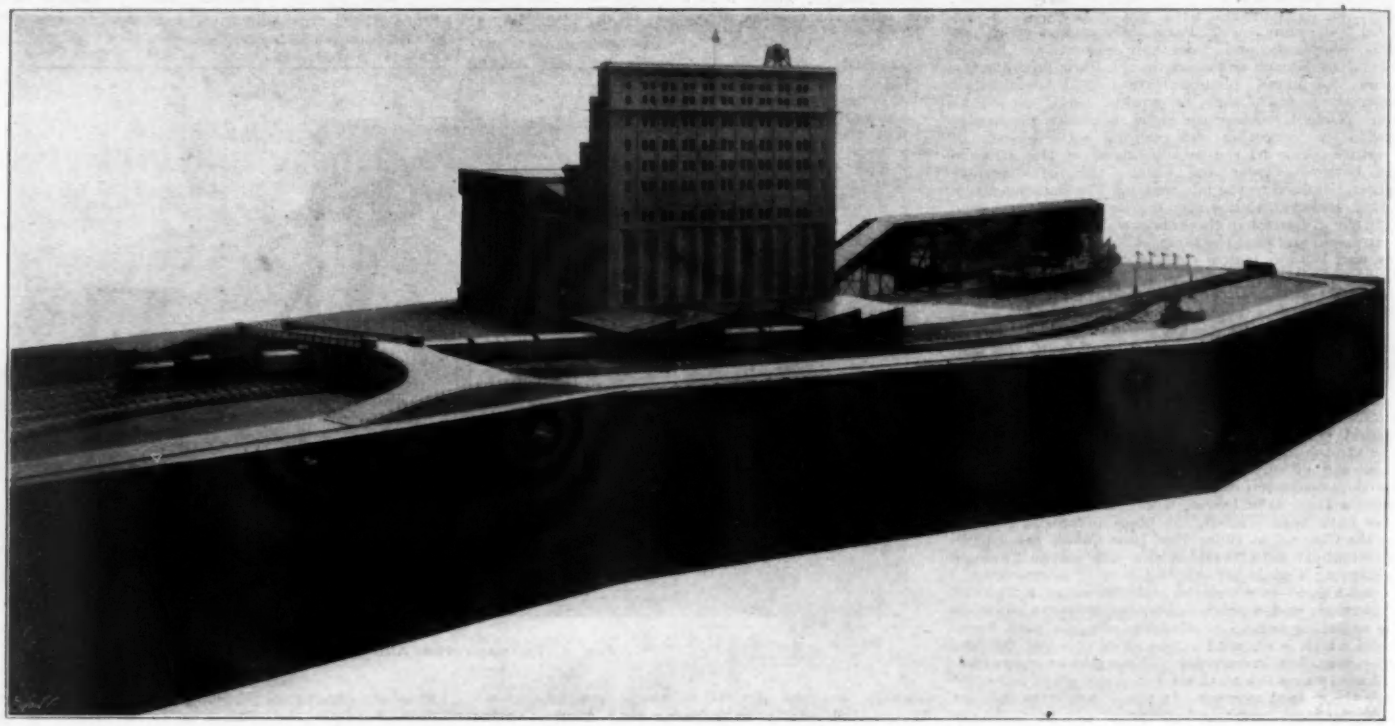
The system is one which is calculated to give politicians full confidence to launch forth expensive social schemes, and traders to shrivel up with caution, because they feel they are subject to political and not economic forces. Then come the blizzards.

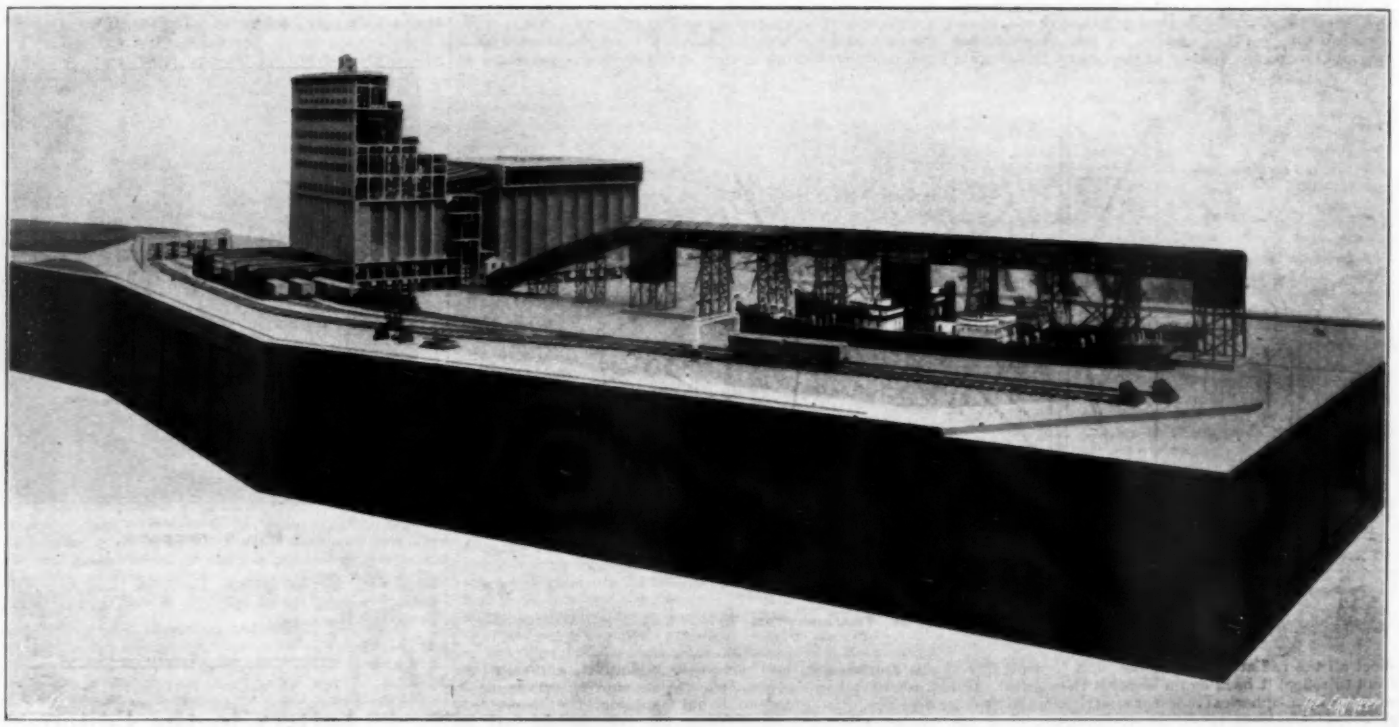
R. DOUGLAS ARCHIBALD, D.Sc.

April 7th, 1931.

BUENOS AIRES EXHIBITION—MODEL GRAIN-HANDLING PLANT

HENRY SIMON, LTD., MANCHESTER, ENGINEERS





Working Model of Grain-Handling System.

The illustrations above represent part of a working model of the grain handling system and the large terminal elevator at Ingeniero White, in the Argentine, which has been constructed by Henry Simon, Ltd., Cheadle Heath, Manchester, to the order of the Argentine Railway Companies. The model is one-sixtieth of the full size and measures 74ft. 2in. long by 11ft. 6in. wide, and the mechanism is operated electrically. It demonstrates the builders' most modern methods of handling and storing grain and delivering it to ships for transport overseas, and is at the British Empire Trade Exhibition, which was opened at Buenos Aires on March 14th. The whole system of dealing with the grain from the wheat field to the ship is shown in the model by exact replicas in miniature of the actual plant and buildings used at the different points. The "field" and "camp" extend from the left of the park shown in our illustrations. The wheat is cut by means of self-propelled harvesting machinery, mechanically threshed, and then transported to the camp silos in motor vehicles or horse-drawn wagons, where the grain is discharged direct to the silos for storage until required. The grain for export is automatically delivered from the silo to bulk railway wagons, which transport it to the terminal elevator at the port, where it is again stored until the ships are ready to receive it.

For delivery to ships the grain is transferred by elevators and conveyors to a gantry on the harbour quay, alongside which the ocean-going vessels are lying. The gantries are provided with conveyor belts, from which the grain is discharged through numerous spouts direct into the ships' holds. Two camp silos are shown on the model. At the silo near the lake horse-drawn carts are shown transporting wheat from the adjacent farms, whereas at the other silo motor vehicles are employed. The furthermost silo is not actually in operation, but has been included to indicate the system of a chain of silos which in a complete system would be installed at convenient points throughout the wheat-growing areas. The camp silo, which is seen at about the centre of the model, is in operation and the grain is brought to the silos by motor wagons fitted with mechanically operated discharging gear, is weighed and then discharged automatically to an underground hopper which feeds an elevator inside the silo. The elevator is of the bucket and endless band type and lifts up the grain to the top of the silo, where it is tipped out and is delivered to horizontal endless belts. By a simple means the grain is diverted from the conveyors and delivered to circular storage bins. For loading out to rail for transport to the terminal elevator the grain is drawn from the bottom of these bins, weighed by automatic machines, elevated to the top of the silo, and is then delivered through a spout in the wall of the working house to bulk wagons alongside. The locomotive and bulk grain wagons are exact models of the actual rolling stock in use on the Argentine railways for grain transport, the wagons being built on the side-opening principle. The terminal elevator model is a miniature of the reinforced concrete structure which is now being built and equipped by Henry Simon, Ltd., at Ingeniero White for the Buenos Aires Great Southern Railway Company. The outer wall on the dock side has been removed to show the internal construction of the elevator and the elevating, conveying, cleaning, and weighing machinery on the various floors.

On arrival at the elevator the bulk wagons can be seen discharging their loads of grain into hoppers below. The grain is then elevated to the storage bins in the elevator building and is finally drawn off from the bins and transported by the conveyors in the gantry for spouting into the steamers lying on either side of the quay. A section of the loading-out gantry has been removed to show the conveyors. The elevator system at Ingeniero White will comprise a terminal elevator of 80,000 tons capacity, a railway wagon unloading plant, grain weighing, cleaning and handling plant, and extensive shipping galleries, one of which is shown in the model.

When the new plant has been installed the wagons will be run into a large unloading shed, which will be situated alongside the working house of the new granary. There will be six railway tracks, compared with four shown in the model, and forty-eight unloading hoppers, each capable of handling a 45-ton truck load. Conveyors will be arranged below each line of hoppers for carrying the grain into the working house. By the above-mentioned means it will be possible to unload twenty-four trucks simultaneously and to have twenty-four more in readiness. The new granary

is being built at a point convenient for linking up with the two existing granaries at Ingeniero White. It is a reinforced concrete building and will be divided into three main sections—working house, main storage building, and shipping house. There will be accommodation for approximately 60,000 tons of grain in the main storage building and 20,000 tons in the working house. The working house will be 210ft. long by 100ft. wide and 220ft. high. It will have five floors in addition to the ground floor. Under the second floor there will be 130 concrete storage bins, and the principal equipment of the working house will include six receiving elevators, each with a capacity of 500 tons per hour, six 50-ton receiving dormant hopper scales, numerous belt conveyors and elevators for transporting and turning over the grain and for transferring it to the main storage building or to the loading-out conveyors. Cleaning and separating machinery will also be installed, including twelve disc separators, twelve oat clippers, dust collectors, fans, &c.

The main storage building will comprise a block of 108 circular bins and eighty inter-space bins and will measure 220ft. by 167ft. wide. There will be six covered connecting galleries between the top of the main storage bins and the second or bin top floor of the working house. Machinery for grain handling will be provided both above and below the bins.

The shipping house, 220ft. long by 50ft. wide, will have twelve shipping elevators and weighers and fourteen belt conveyors, each with a capacity of 500 tons per hour. Twelve of these conveyors will be used for loading grain out to ships and two for linking up with the two existing elevators. The new plant will have a loading-out capacity of 6000 tons of wheat per hour to ships and 1000 tons per hour to the existing granaries.

For loading-out purposes the sixteen lines of conveyors will be continued from the lower floors of the shipping house in overhead steel galleries, which will connect the new granary with the existing No. 1 granary and with the new jetty. This will be of concrete and will carry a steel shipping gallery in which will be arranged eight lines of conveyors, with provision for four more in the future. There will be four additional berths alongside this jetty—two on each side—and grain will be spouted direct into ships from the conveyors in the gallery. Four sacking stations will be erected on the new mole under the main shipping gallery for loading out grain in sacks.

The whole plant will be electrically driven by independent motors totalling 8600 horse-power.

New Automatic Gear for Friction Drop Stamps.

THE operation of the ordinary friction drop stamp made by B. and S. Massey, Ltd., Openshaw, Manchester, as is well known, is controlled by hand, the operator

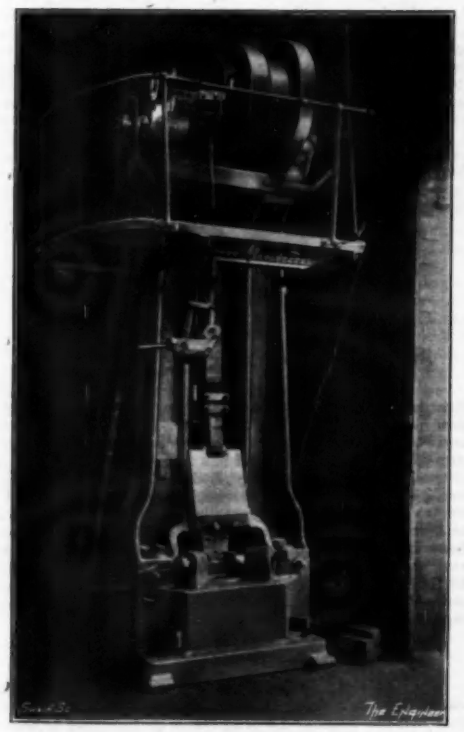


FIG. 1—AUTOMATICALLY-OPERATED FRICTION DROP STAMP

pulling a catgut cord to lift the tup, then releasing it to allow the tup to fall. The cord passes round a constantly rotating shaft, and is attached at its upper end to the lifting mechanism where it actuates an excentric, which, in its turn, tightens the friction band on the revolving drum. Messrs. Massey have now introduced the new automatic mechanism shown in the illustrations, Figs. 1 and 2, for actuating the pulling cord, much as the driver does in the hand-controlled stamp. In this new device a spring P acts on the cord to raise the tup, and the action of the latter is reproduced on a smaller scale by a trip rod D, which, when the tup is lifted to the desired extent, operates toggle mechanism E, relieves the cord, and locks the spring out of action. The tup then falls until a lower trip Z releases the toggle and allows the spring to act as before, when the tup is again lifted. Both the upper and lower trips are adjustable by a simple single-handed movement W S, the upper trip regulating the stroke to any length between 2ft. and the maximum and the lower trip adjusting the "pick up" to suit dies of various heights. When the automatic gear is in action the stamp is controlled by a foot lever, which actuates the "hold up" gear. This gear permits the tup to rise, but prevents it from falling. When the foot lever is depressed the hold-up gear is put out of action and the tup falls, actuating the lower trip of the automatic gear when it reaches the bottom of the stroke. Thus so long as the foot lever is held down the tup continues to rise and fall. When the foot lever is released the tup rises to the top of the stroke for which it is set, and is there held up without consuming any power

The force of any automatic blow may be modified by slightly raising the foot lever, and thus allowing the hold-up gear to drag as the tup falls. Single blows can be made by depressing the foot lever until the blow has been

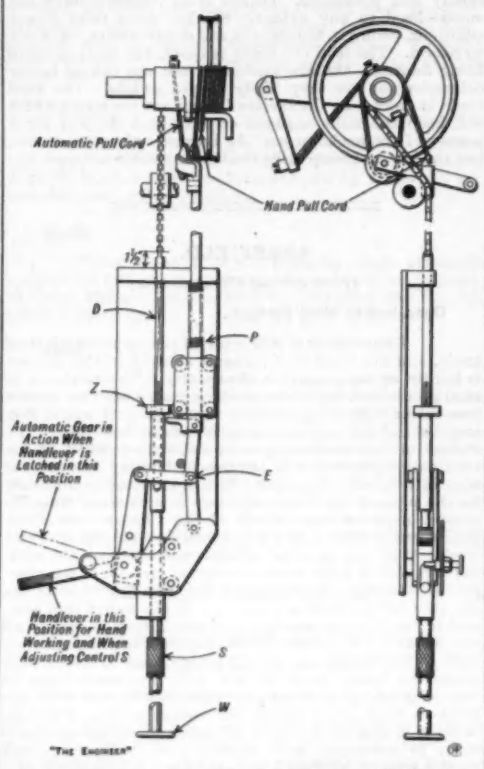


FIG. 2—AUTOMATIC MECHANISM FOR FRICTION DROP STAMP

struck, and then releasing it so that the tup is again held up.

The mechanism is of simple construction, the trips being fixed on a separate rod which reproduces the movements of the tup on a much smaller scale are quieter in action than the board drop stamps in which the tup itself operates the trips. A further advantage which the makers claim for this new gear is that it is quickly set and regulated without the use of spanners. Being a separate unit, the gear can be readily applied to existing stamps.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Holidays.

THE week has been uneventful in the Midlands and Staffordshire, the greater part of the works having been idle throughout a portion, if not the whole, of the week on account of the Easter holidays. Usually operations are recommenced about the middle of the week, but order books this year were so thin that manufacturers, in most cases, decided upon a protracted vacation, hoping that, in the interval, orders would come along which would enable them to resume with some prospect of an improved output on the pre-holiday period. Monday next will see the greater portion of the works reopened, though it does not appear that anything beyond the recent restricted operations will be possible. Attention is now being given to the Quarterly Meeting of the Midland Iron Trade, which takes place in Birmingham on Thursday next, and hopes are entertained that it will produce more business than its recent predecessors have done. Much has been written in the daily Press of the spring trade revival, and iron and steel masters, engineers and manufacturers in this area think that if such a rehabilitation of demand is likely, evidences of it will be seen at the quarterly meeting. It is customary for consumers of iron and steel and other materials to endeavour to estimate their requirements over the next three months, and to enter into negotiations with suppliers for material to cover that period. Of late it has been almost impossible to forecast future requirements, and at the quarterly meetings, though inquiries for bulk supplies have been made the actual business placed has been for small tonnages only. Week-to-week supplies are all that have been ordered, and iron and steel mills have, consequently, experienced considerable difficulty in arranging rolling programmes. The position would be made very much easier if consumers could be induced to place contracts, and this is what producers are hoping for at next week's quarterly meeting. Whether there is sufficient confidence in the future of trade to warrant users taking this action remains to be seen, and though there are optimists who believe it possible there are also those who very much doubt it. Careful inquiries at Midland works just before the holidays failed, in the heavy branches at any rate, to reveal any improved demand for finished goods, and there were few, if any, firms which had tangible evidence to offer of the probability of better employment at their works in the near future. Most of them admitted that the outlook was as obscure as at the beginning of the year. In some of the lighter metal trades and in the automobile industry there is some promise of an improvement, but this, if fulfilled, though very welcome, is hardly likely to be of such dimensions as to improve materially the position of the large iron and steel producing works in this district. It is much to be hoped that after the holidays the increased momentum ordinarily associated with the spring will develop, for nowhere is it more needed to-day than in the Midlands.

Staffordshire Bar Iron.

There is no improvement in demand for Staffordshire bar iron, and dull conditions rule throughout the industry. Practically all the works are idle the whole of this week, and order books on which a resumption of operations will be made are sparsely filled. Before the Easter break a large number of the mills were only operating three days a week, but inquiries in circulation gave promise of better business in the near future. It is not anticipated that orders of any extent will be given out until the quarterly meeting next week, so that until then operations at the ironworks are likely to be of a restricted character. The marked bar mills which, for a long time past, have been the most active in the industry, have but few contracts on their books. Orders come in week by week with fair regularity, but ironmasters cannot look ahead with any degree of certainty. For their part, therefore, they are limiting their purchases of raw material to known requirements. Values of best grade bars are firmly held at £12 10s. per ton, producers being of opinion that nothing is to be gained by alteration of prices in the present state of demand. The Crown bar branch is as lifeless as during recent months, and efforts to stimulate buying by offering material at reduced rates have proved abortive. Staffordshire makers continue to complain of underselling by makers in other districts. There is little business, however, going to anyone these days. Supplies could, possibly, be obtained at £9 12s. 6d., but quotations on this market rise from £9 15s. to £10 upwards, according to the reputation of the mill for quality, &c. Makers of bars for the nut and bolt and fencing industry receive little support, the major portion of the available business going to the Continent on account of price. Local ironmasters continue to quote £8 15s. upwards. Foreign prices have become slightly firmer, but there has been no marked advance in selling rates of No. 3 iron. Wrought iron gas tube strip is maintained at £10 17s. 6d. per ton. Demand keeps up well and some producers are favourably placed when compared with those in other branches of the iron trade.

Steel.

The market for finished steel is in a very poor state, and works in this district are badly off for orders. They are mostly running at about 50 per cent. of their productive capacity. Specifications for structural steel are usually for light tonnages, as Midland engineers have not met with any improvement in contracting. Where stocks of material needed replenishing for use after Easter, arrangements had been made for supplies, so that there was little buying this week. A few special steels are in comparatively brisk request, but they stand out in sharp contrast to the trade as a whole. The Association selling prices are maintained. Angles are £8 7s. 6d. less 15s. rebate; tees, £9 7s. 6d., less 15s. rebate; joists, £8 15s., less £1 2s. 6d. rebate, and ship, bridge and tank plates, £8 17s. 6d., less 15s. rebate. Boiler plates, which are quieter than of late, sell at £9 2s. 6d. upwards. The market for uncontrolled steel is weak. Soft billets can be bought at £5 5s. and re-rolled bars at £7 2s. 6d. Users in this area of small steel bars say they can now buy from re-rollers at £7, but that figure is below the rates generally recognised. There is a firmer tone in continental material. Buying has not increased perceptibly, however. Foreign prices have been extremely low, and makers in France and Belgium are evidently now endeavouring to make a stand for more remunerative rates.

Raw Iron.

Consumption of raw iron is not improved, and this week, with works idle, sales have been few and far between. Users in the Midlands have practically no material in stock and, accordingly, additional orders must be forthcoming when the works restart. Forward contracting, however, is not probable. Foundrymen, at any rate, are likely to continue their policy of hand-to-mouth buying, as they are still dissatisfied with the price levels fixed by the smelters' combine. Pig iron is in over-supply. Here and there foundries are moderately well employed, but, generally speaking, there is no perceptible improvement. A Northamptonshire furnace, with a normal output of about 750 tons per week, has been stopped for repairs. The effect upon the market is negligible. Values are upheld. Derbyshire and North Staffordshire No. 3 foundry at £3 11s., and forge at £3 6s., and Northamptonshire foundry at £3 7s. 6d. and forge at £3 2s. 6d. Blast-furnace coke is in ample supply at recent rates.

Galvanised Sheets.

Some Midland galvanised sheet mills have strengthened their position slightly, but business, on the whole, remains disappointing. Overseas buyers are taking only limited tonnages and orders are difficult to obtain in face of severe competition from Belgian suppliers. Native makers uphold their quotations on the basis of £11 per ton for galvanised corrugated sheets of 24-gauge. India continues to be the most active market and recent trade returns show that that country is still buying more sheets from Great Britain than any other country. The home market calls for a moderate amount of sheets, and demand from this quarter keeps up well. Black sheets for the automobile industry are selling better and prospects in this department are brighter. Values are unchanged.

Coventry Aero Industries.

The aircraft and aero engine industries of Coventry continues to prosper. Work upon the four-engined air liners, to which I recently made reference, is proceeding satisfactorily, and this week the Finnish Government has placed an order for thirteen Armstrong-Siddeley "Jaguar Major" engines for the Finnish Air Force. This contract has been secured in face of keen American and French competition.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Hiding a River.

APPLICATION is being made by Stockport Town Council to the Ministry of Health for permission to borrow the sum of £30,000 for the purpose of carrying out the Mersey-square section of the scheme for covering the river Mersey, which runs through the town, and at the same time constructing a new road over the river from Mersey Bridge to Lancashire Bridge. The scheme is an old one and has been discussed by the Stockport authorities on many occasions. Parliamentary powers to carry it through have been secured, and a year ago it was announced that a Government grant representing 75 per cent. of the capital cost would be made. Since then, however, the offer has been reduced to 60 per cent., with repayment spread over a period of fifty years. Stockport is badly in need of a modern road running east and west through the town, and as the alternative to the river-covering scheme would be a more costly widening of Prince's-street, the former, especially in view of the fact that the river Mersey in the neighbourhood of Stockport is anything but a beauty spot, would appear to present an admirable opportunity of killing two birds with one stone.

Shipbuilding on Merseyside.

It was pointed out by Mr. W. L. Hichens at the annual meeting at Liverpool of Cammell Laird and Co., Ltd., that the company's mainstay had been the Birkenhead yard, the trading profit from which had increased from £58,236 in 1929 to £91,237 last year. The company's profit, after providing for depreciation, debenture interest, and other charges, amounted to £28,083 against £11,809 in the previous year. Mr. Hichens announced that since the end of last year the company had secured orders for a cruiser and also for two vessels for the Great Western Railway Company. He further said that the Cunard Company had stated that when it was decided to order the second of its new giant liners, the claims of Cammell Laird's Birkenhead yard would be carefully considered.

Obituary.

The death has occurred at the age of sixty-one years of Mr. W. Boyes Richardson, managing director of Richardson, Tuer and Co., Ltd., Hope Foundry, Farnworth, near Bolton. Mr. Richardson was well known in the Lancashire engineering trade and was a member of the Council of the Federation of British Industries.

Non-ferrous Metals.

Another week of mixed conditions has been experienced on the market for non-ferrous metals. The holidays have naturally restricted buying opportunities, but the demand for most descriptions from industrial consumers is quiet, speculative operations making up the bulk of current transactions. Heavy increases in the home stocks of tin and a certain amount of uneasiness, in spite of the new restriction scheme as to the statistical situation generally have had a bearish influence on prices in this section, particularly in the opening days of the present week, the net loss on balance at the time of writing being well over £2 a ton. Copper consumers have displayed comparatively little interest in the market, so far as actual buying is concerned, and prospects are regarded less hopefully at the moment than they were a month or so ago. The actual loss since my last report has been less serious than in the previous week, but the fact that values of standard brands are lower to the extent of about 5s. reflects the spirit of the market. An interesting feature has been a slight firming up in lead, and on the strength of a possible further reduction of output by 15 per cent. a fair tonnage of the metal has been bought, prices advancing by 5s. to 10s. The low rates which spelter has touched attracted some attention, and values have strengthened by several shillings a ton.

Iron and Steel.

Business has been seasonally slack on the iron and steel markets this week. The demand for pig iron has been very poor, and deliveries have been on a smaller scale than usual in consequence of the holidays and the closing down of foundries, in several instances for extended periods. Sellers are hopeful, however, of a return to reasonably active conditions by the beginning of next week. In the meantime, quotations are steady on the whole, with Derbyshire, Staffordshire, and Cleveland makes obtainable at 69s. 6d. per ton, for delivery in the Manchester price zone, Scotch at about 89s. 6d., and West Coast hematite at 82s. 6d. Sales of bar iron have been poor, but prices keep up at £10 5s. per ton for Lancashire Crown quality bars, and £8 15s. for seconds. Apart altogether from the holiday influences, the outlook with respect to steel in the Lancashire district, more especially among constructional engineers, is disappointing, and prospects of any immediate return to better conditions seem at the moment to be remote. Forward buying from almost all classes of steel users is virtually at a standstill, and current orders are rigidly restricted to what amounts to little more than an early rolling programme basis. Small re-rolled bars contine weak at from £6 15s. to £7 per ton, with sections at £8 7s. 6d., joists at £8 15s., general plates at £8 17s. 6d., boiler plates at about £9 2s. 6d., and large-diameter bars at £9 7s. 6d.

BARROW-IN-FURNESS.

Hematite.

The holidays have interfered with steel production, and they have considerably reduced the demand for iron locally. On the other hand, the general business in pig iron is maintained, and although customers are on the whole disinclined to place orders for forward delivery, the general tone is fairly good, and there is every sign of present prices remaining firm. There is a tendency on the part of home buyers to increase their tonnage to a slight extent, and business with the Continent remains steady and promising. Orders from America have not materialised to any extent. Stocks, apart from recent additions, owing to holidays in rail departments, have not increased. The iron ore trade is quiet, the local demand being limited. Outside customers are not taking heavy deliveries nor are they likely to yet awhile. The steel trade is quiet. In Cumberland there are contracts which will keep the mills engaged on rails and sleepers for a matter of six weeks or so. At Barrow orders are scarce, but the bar and hoop mills are better situated.

SHEFFIELD.

(From our own Correspondent.)

Open-hearth Steel Position.

DEPRESSION is still acute in the open-hearth steel trade, and the number of furnaces at work in this district is hardly up to a quarter of capacity. The statistics of steel production for February show that, while that month was better than its immediate predecessor, it was a long way behind the corresponding month of last year. The output in the Sheffield area in February totalled 83,000 tons, as compared with 65,100 tons in January, and 102,100 tons in February last year. It is a striking commentary on the present condition of things in this trade that the great Templeborough Works of the United Steel Companies are closed in all departments for the whole of this week. It is very unusual to cease operations at the melting furnaces of these works, except at the end of the year, for stocktaking. The demand for open-hearth steel has shown a falling tendency since the beginning of this year, and it has been necessary to curtail output at nearly all the works. The trade is now experiencing the quietest time it has known for a long period, and inquiries with regard to future work do not hold out much hope of improvement. The figures for Lincolnshire show that the position there is no better, but rather worse. The production in that area during February amounted to 34,800 tons, as compared with 37,300 tons in January, and 68,400 tons in February of last year. Lincolnshire also produced 36,600 tons of pig iron, as against 41,300 tons in January, and 70,400 tons in February last year.

Heavy Steel Manufacture.

There is still a very poor call for shipbuilding steel, orders for new ships being scarcer than ever. Negotiations which are proceeding for the building of some ships for the Soviet Government hold out a certain amount of hope, but it is yet too early to predict the outcome of the movement. The railway steel departments are also poorly employed. The home railway companies cut down their specifications at the beginning of the year, owing to the possibility of trouble with the workpeople over wages questions. Now that that trouble has been averted, it is expected that the various companies will place increased business, as their stocks must be nearly exhausted. The shops devoted to the production of axles, tires, and springs are looking for more active times as a consequence. They are also anticipating orders in connection with the Chinese indemnity allocation. Some more orders for steel rails have been placed during the past week, the L.N.E.R. Company having allotted contracts for a total of 40,000 tons with various British companies. One of the firms to benefit is that of S. Fox and Co., Stocksbridge, near Sheffield, which is a branch of the United Steel Companies. The rails are to contain a higher percentage of manganese than hitherto. There is a fair amount of heavy forging work on hand, in connection with the production of hollow rolled boilers and other drums. The building of wagons for private owners is on a very small scale.

New Uses for Stainless Steel.

The leading firms making stainless steel and kindred materials are enjoying moderate activity, and the range of usefulness of these steels is being constantly extended. One firm has recently installed a 20-ton electric furnace which is to be employed entirely on the melting of stainless steel. Firth's Staybrite steel has been adopted for the construction of a shop front in one of the main streets of Sheffield, and the work has attracted much attention. The material not only gives a permanent silver-like appearance, but also has great strength and durability, is immune from corrosion, and dispenses with polish and such expensive preservatives as paint and varnish. Its use in shop fronts is a novelty in Sheffield, but it has been adopted in many cases in London and other cities. One of the new directions in which rustless steel has recently been adapted to commercial purposes is the manufacture of pit bottoms for paper pulp mills, in substitution for porcelain. These articles, which are made by Samuel Osborn and Co., Ltd., last longer when produced from rustless steel. Each of them is 32ft. in diameter, and has 600,000 holes punched in it.

Firth-Brown Fusion.

The latest instance of rationalisation in the Sheffield steel trade, brought about by the amalgamation of the steel interests of the two old and celebrated firms of Thos. Firth and Sons, Ltd., and John Brown and Co., Ltd., is now in actual operation, the arrangement having formally taken effect on March 31st. Messrs. Firth have changed their name to Thos. Firth and John Brown, Ltd., and will carry on the Norfolk (Sheffield) and Tinsley works of Firths and the Sheffield and Scunthorpe works of Browns. A circular issued by Messrs. Firth states that the joining of the interests will in no way interfere with the production of the respective specialities of the two companies. John Brown and Co. will continue to carry on separately, under their name, their shipyard at Clydebank and their collieries in South Yorkshire.

Wreckage from the "R 101."

The contract for the dismantling of the wreckage of the ill-fated "R 101" at Beauvais was obtained by the Sheffield firm of Thos. W. Ward, Ltd., and much of the material has now been brought to the city. This consists of high-tensile and stainless steels, duralumin, aluminium, and valuable alloy metals, which has been distributed and remelted, to be used in Sheffield manufactures. Some of the material is being used by the Laycock Engineering Company in the manufacture of their new L.S.D. one-gun hydraulic car-washing equipment.

Humber Bridge Model.

A working model of the proposed bridge across the Humber will be an object of interest at Westminster when the Bill seeking powers to construct the bridge comes before the Parliamentary Committee. The model has been constructed in the Engineering Department of Manchester University, at an estimated cost of £1600, of which the Ministry of Transport is bearing 75 per cent. It is hoped by its aid to demonstrate that the bridge—to the erection of which there is much opposition—would not have a prejudicial effect on the *régime* of the river. The model is between 30ft. and 40ft. long, and is worked electrically. In the tank containing it, samples of mud, sand, silt and water taken from the Humber have been deposited, and an attempt has been made to reproduce the natural features and conditions that exist in the river. Winds, rain, and tides are created by artificial means. The model is so geared that in twenty-eight days twenty-eight tides are represented, from spring tides to neap tides. It has been put through a series of tests by running it for certain periods, one week's operation representing ten years in the life of the river.

The Lighter Trades.

There has been some spring improvement in the sales of cutlery, spoons and forks, and electro-plated articles to the distributors in this country, but, generally speaking, conditions are very bad. The small aggregate amount of trade is leading to severe competition for orders, accompanied by price cutting. Small makers with limited capital are finding the problem of carrying on an increasingly difficult one. On export account there are some fair orders on hand from South Africa and Scandinavia, but trade with other overseas markets has fallen to a very low level. No silver or plated hollowware goods have gone to Australia for more than a year, and the embargo is still in force. A fair amount of activity is to be found in the safety razor blade branch. The scissors department, which made considerable progress until recently, is now suffering from severe German competition. For hand and engineers' small tools there is a moderate home demand, but trade with all overseas markets is severely depressed. There is a good sale for Sheffield hacksaws in the home market, as well as in several on the Continent. The seasonal demand for farm and garden tools is quiet, while orders for tools to be used on the railways and in shipbuilding are much below the average.

NORTH OF ENGLAND.

(From our own Correspondent.)

Rustless Steel Industry.

IT is expected that the works of the Darlington Rustless Steel and Iron Company, Ltd., will reach production stage some time next month. The firm is the sole licensee in Great Britain of a new process for the manufacture of stainless metals, and has taken over the old shops of the Blade Boiler Company, Ltd., at Albert Hill, Darlington, which have been thoroughly reconditioned. An electric furnace is being installed under the supervision of Signor Tagliaferri, the Italian inventor and engineer. Some sixty men will be employed at the works at the outset, and orders for raw materials have already been placed. The firm has also received a number of inquiries from potential purchasers of its products, which will be mainly ingots of all shapes and sizes.

Iron and Steel Exports.

Cleveland's export trade in pig iron is approaching vanishing point under present conditions. Each month this year has witnessed a progressive decline, and in March the tonnage shipped was the smallest since the period of the coal strike. The figures for the three months of 1931 are: January, 14,222 tons; February, 11,380 tons; March, 7258 tons. Of the March total, 4282 tons went to Scotland and other coast ports, leaving only 2976 tons for export to other countries abroad. On the other hand, the manufactured iron and steel shipments from the Tees were substantially heavier, the March figure being 44,122 tons, compared with 31,357 tons in February. The increase was chiefly due to an expansion in the trade with South Africa, but an improved business was also done with India, and orders in hand promise a continuance of the improvement in steel exports.

Cleveland Iron Trade.

There is a much more hopeful feeling in the Cleveland pig iron trade. The placing of the big railway orders will necessarily involve a substantial consumption of pig iron, and reduce the quantity at present available for the open market. There are, too, signs of a modification of the hand-to-mouth policy of purchasing which has been pursued for so long by most of the pig iron con-

sumers, and a few contracts are reported to have been arranged for delivery up to the end of June. Sales for export and to Scotland are very limited, but some expansion in home needs is indicated, and prices are firm, No. 1 foundry being 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

East Coast hematite values are not maintained, but makers are reluctant to acknowledge they grant price concessions. Customers state they experience no great difficulty in covering their requirements on the basis of ordinary brands at 67s.

Ironmaking Materials.

Sellers of foreign ore still name 16s. as the c.i.f. Tees price of best Rubio, but transactions last recorded are understood to have been at a much lower figure. Blast-furnace coke is plentiful, and 16s. is a full quotation for early delivery of good average qualities to works in this district, but sellers are not disposed to do forward business at that price.

Manufactured Iron and Steel.

Activities at the steel works are still restricted by the slump in shipbuilding, but in other departments of the steel trade bookings are on a rather better scale. Three Tees-side firms have shared in the order for 40,000 tons of steel rails given out by the L.N.E.R. Company—Dorman, Long and Co., Ltd., Cargo Fleet Iron Company, Ltd., and Pease and Partners, Ltd. Manufactured iron and steel quotations are steadily maintained.

Blast-furnacemen's Wages.

Under the quarterly ascertainment issued by the Cleveland Ironmasters' Association on Wednesday, the wages of blast-furnacemen employed at North-East Coast ironworks have been reduced for the current quarter by 2½ per cent. In twelve months they have suffered reductions aggregating 12½ per cent. The average net selling price of No. 3 Cleveland pig iron, by which the wages are regulated, was certified at 56s. 3·37d. per ton for the past quarter.

The Coal Trade.

Holiday influences have interfered with the normal course of business in the Northern coal trade, but the immediate signs for all April are encouraging. Screened steams come first in point of firmness, and after them best bunkers and best gas are most favourably circumstanced. Coking fuel and secondary gas and bunkers are the uncertain features, and it is hard to say what is in store for them. Northumberland and Durham have each begun the new quarter with a quota of 75 per cent. of the standard tonnage. There was recently an idea that monthly quotas might be more convenient than quarterly quotas, but there did not appear to be much support for it, so the quarterly arrangement is likely to be the established thing. If trade is good, the quota can be adjusted to meet the circumstances of the moment. If collieries greatly oversell in the early part of the quarter, as some in Yorkshire did in the past three months, they cannot be surprised if they are confronted with idle days near the end of the quarter. In the past quarter Northumberland worked on steady lines, and, starting at 75 per cent., was within the revised quota of 86·9 per cent. at the end of March. Durham, too, had a raised quota—about 90 per cent.—but it did not absorb that quantity. Minimum prices are likely to continue at the present figures. There were few alterations in the past quarter—a fact that shows that the experimental stage was marked by fairly smooth working. It was said, notably in respect of certain Durham classes, that foreign consumers would not pay the limitation prices, but a good deal of trade was done all the same. The minimum prices should not be disturbed, it is thought, until they have had a much longer trial than three months, for changes would be certain to have an unsettling effect on buyers abroad, who would, doubtless, adopt a waiting policy to see if any further alterations were likely to take place. So far as steam coals are concerned, there does not seem to be any justification for revising them at present, as Poland, the keenest competitor of this district, obtained good prices in some recent Scandinavian contracts. In Durham the trade for secondary grades of fuel has been so irregular that it is hard to say how low prices might have gone if there had not been the limitation barrier. The "bears" would have become masters of the situation.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

THE output from Clyde yards during last month was the smallest on record for the month of March. In the year 1886 the March output was only 8169 tons, but since that year until the March of this year the output for that month has never fallen below 20,000 tons. Since the beginning of this year the tonnage launched per month has shown a drop equal to half the preceding month's total: January, 31,642 tons; February, 15,072 tons; and March, 6543 tons. The amount of new tonnage booked during recent months has been exceedingly small, as can be seen from reports indicating that seven Clyde yards are empty and eight yards have only one vessel on the stocks. Nothing fresh in the way of new tonnage was reported during March, and under the circumstances perhaps more than usual interest is being taken in negotiations which are in progress with respect to probable orders for the Soviet Government.

Ship Repairs.

A fair amount of repair work is on hand, and in this connection it is a source of satisfaction that an important contract was secured by a Clyde yard in competition with British and continental firms. The contract referred to is that for repairs on the "Buteshire," belonging to the Scottish Shire Line, Ltd. She is a 6500 gross ton steamship, built and engined in 1912 by Palmer's.

Steel and Iron.

The steel and iron trades still lack signs of improvement, and nothing has happened of late calculated to hold out the least encouragement. Sheetmakers are very short of orders for all classes of material, and plants are irregularly employed. Plates and sections are poorly specified, and sheets, apart from light black varieties, are not particularly well placed, owing to the scarcity of export business. Steel tubes are inactive. Bar iron makers are disappointed at the delay in the usual seasonal expansion of trade at home and for overseas, while steel re-rollers experience great difficulty in securing business in competition with English and continental makers. Re-rolled steel bars are quoted £6 10s. home and £6 7s. 6d. per ton export.

Pig Iron.

The demand for pig iron is extremely limited, and supplies are ample. Foundry qualities are unchanged in price, but hematite has been reduced by 2s. to 72s. per ton, delivered at steel works.

Scrap.

Scrap material is not engaging much attention meanwhile, and prices are easy and practically unchanged, at about 55s. per ton for cast iron machinery and 47s. 6d. per ton heavy steel.

Coal.

Quietness in the export department is the dominating note in the coal market. Demands from abroad are restricted and shippers are only obtaining a small portion of the business offering, owing to their inability to quote prices acceptable to foreign importers. Owing in a measure to restricted outputs, Lanarkshire splints and steams in Fifeshire, and in a lesser degree the Lothians, are comparatively firm, with outputs moving steadily. Small stuffs are most irregular. Treble and double nuts, particularly the former, have a moderate turnover, but smaller sizes are more than plentiful.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade: Egyptian Railway Contract.

NOTHING took place in the holiday period which made any material alteration in the general conditions governing the coal trade. The position from the loading point of view is fairly satisfactory, and most collieries had a ready outlet for coals when work was resumed on the docks on Wednesday last. The fact that work at the pits was not restarted until the night shift on Wednesday meant that collieries had an opportunity of diminishing some of the standing stocks of coal, but so far as new business for early shipment was concerned, there was not much evidence that many fresh orders had come along during the vacation. Most interest as a consequence has centred around contract operations, chiefly that in respect of the inquiry for 300,000 metric tons of locomotive coal for the Egyptian State Railways to be delivered at Alexandria from June to September. Tenders for this were opened at Cairo on Tuesday, and have to hold good for about a fortnight, and the information to hand is that the lowest offer has been put in by the Maris Export and Trading Company, Ltd., of 25s. 5d. c.i.f. Alexandria for 150,000 tons, while Gueret, Llewellyn and Merrett, Ltd., come next with an offer for the whole quantity at 25s. 7d., other prices for Welsh coals ranging up to just over 27s. One offer for the supply of 100,000 tons of American coal at 27s. 6½d. is also reported to have been sent in, but the probabilities are that the business will be placed for Monmouthshire coals. The last contract which was placed and is now being carried out was secured by Gueret, Llewellyn and Merrett, Ltd., at the price of 24s. 8½d., so that it will be seen that the lowest offers now sent in show a slight increase. It will be interesting to see what decision the railways come to, viz., whether they accept the lowest offer for part of their requirements or place the contract for the whole of the quantity with Gueret, Llewellyn and Merrett, Ltd., at the increased price of 25s. 7d. per ton.

Coal *v.* Oil.

An address delivered to the members of the Cardiff Business Club in the early part of last week by Captain Bernard Acworth, D.S.O., R.N., in which he emphasised the danger of this country depending on oil fuel and advocated its return to coal-burning ships, has very naturally aroused the greatest possible interest in this district, which has suffered so much by the reduced consumption of coal by the Navy. At one time the Admiralty purchased annually about 2½ million tons of Welsh steam coal, but last year it is estimated that its contracts only ran to about 200,000 tons. Several of the leading coal-owners have expressed themselves very strongly on the subject of the Government reversing its oil policy, and steps are being taken to press forward the matter. According to Mr. Finlay Gibson, the secretary of the South Wales Coalowners' Association, three representatives of that organisation approached the Mining Association of Great Britain on the subject, and the result of subsequent correspondence between the Mining Association and the Admiralty was that the latter had agreed to receive a deputation to consider the whole matter. A date for this interview has yet to be fixed, but steps would be taken to see that the members of the deputation should be as representative as possible. In the meantime, the Commercial Committee of the South Wales Coalowners' Association had expressed a desire that the case for South Wales should be submitted by its own representatives, as this district was more vitally affected than that of any other coalfield in the country.

Docks Equipment.

Reference has been made from time to time to the steps taken by the Great Western Railway Company to bring the state of the docks in this district to the highest point of efficiency. Recently there was completed new 3-ton electric cranes for the loading and discharging of general cargo at the Queen Alexandra Dock and the Roath Dock at Cardiff. Immediately before Easter a new movable coal shipping hoist was brought into operation at the Queen Alexandra Dock, this hoist being capable of handling 20-ton wagons. Another similar hoist is also nearing completion, while work is proceeding on three others of similar type.

Coalfield Items.

Stoppages of work occur at collieries in this district for a variety of reasons, but the latest is the action on the part of the workmen at the Nine Mile Point Collieries, Monmouthshire. These men suspended operations last week on account of their objection to the introduction of steel props instead of the usual wood props. A deputation of the men interviewed the Executive Council of the South Wales Miners' Federation at Cardiff on Saturday, and complained that the company had introduced these steel props without consulting the workmen. The Council, decided, however, that the workmen should be instructed to return to work, though they were not to erect the steel props until some arrangement is made regarding the matter. The stoppage of work at the Bedwas Navigation Colliery continues, and apparently all efforts made to bridge the difficulties standing in the way of a settlement have failed. Notices to terminate contracts and issued to all members of the official staff expire at the end of this week, so that the outlook is now regarded as more serious than ever. Colliery examiners and shotsmen in the anthracite area decided at Swansea on Saturday last to press for improvements in wages as soon as conditions warranted.

Current Business.

Extremely little business has been done this week on account of the holidays on the Coal and Shipping Exchange, and the fact that so far as the coalfield is concerned, the workmen did not resume until the night men went in on Wednesday night. The result is that production this week will be reduced by practically half, but still there is a fair amount of coal standing, though collieries will be glad of the opportunity of reducing their stocks. Nominally prices have not undergone any alterations, although a few grades can secure a slight premium on schedule prices, owing to the scarcity of these particular coals, such as highly bituminous coals and dry sized coals. So far as can be seen, however, the general demand has not improved over the holidays, and few fresh orders are on the market. Patent fuel is quiet. There was a prospect of a stoppage of work at the Crown Patent Fuel Works at Cardiff arising out of a proposed revision of wages, which at Cardiff are above those prevailing in the Swansea and Port Talbot area. The men, numbering about 350, at Cardiff declined to entertain the reduction which the employers demanded, but fortunately the matter was settled on the eve of the Easter vacation, the pieceworkers having accepted a reduction of 10 per cent. and the day-wage men a reduction of 7½ per cent., operative from the first full week in April. Pitwood rules steady.

New Bridge Scheme.

At a conference held at Neath on Thursday last week of representatives of the Glamorgan County Council, Neath Town Council, Neath Rural District Council, Neath Harbour Commissioners, and the Great Western Railway Company respecting the proposed new bridge over the river Neath at Briton Ferry and the new east to west road, Sir Frederick Palmer, of Westminster, who was appointed on the recommendation of the Ministry of Health, submitted plans and estimates, and eventually the Conference adopted the proposals, which include a new bridge across the river and alternative road sites, the estimated cost of the scheme being between £453,500 and £500,000.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

WHITE'S MARINE ENGINEERING COMPANY, Ltd., Hebburn-on-Tyne, informs us that it has been decided to amalgamate White Oil Separators, Ltd., with the company.

THE SELSON ENGINEERING COMPANY, Ltd., of 26–28, Charles-street, Hatton-garden, E.C. 1, has been appointed sole agents for the Cleveland Automatic Machine Company, of Cleveland, Ohio.

J. ROLLAND AND CO. advise us that an amalgamation has been completed between Messrs. Fried. Krupp Grusonwerke's Cement Machinery Department and Messrs. Andreas Machinery Manufacturing Company. Messrs. Krupp Grusonworks will take over the whole of the cement machinery department of Messrs. Andreas Company, and Mr. Andreas will be the technical adviser to the amalgamated firms.

CONTRACTS.

RICHARD DUNSTON, Ltd., of Thorne, near Doncaster, has received an order from the Crown Agents for the Colonies for a gig, to be built of teak and fully equipped for service in Iraq.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., of Rugby, has received an order for a year's supply of "Mazda" lamps from the Department of Local Government and Public Health, Dublin.

A FLAG-SHEET OF BRITISH-OWNED SHIPS.—We have received from our contemporary, the *Liverpool Journal of Commerce*, a copy of the latest flag-sheet, containing a series of coloured drawings of the funnels and house flags of all the British ship-owning firms. The sheet is well printed and we can recommend it to all our readers who may be interested in marine matters. It is to be obtained from the *Journal of Commerce* offices at 11, James-street, Liverpool, and 14–20, Bishopsgate, London, E.C. 2, at the post free price of 1s. 6d. per copy printed on paper and 3s. 9d. when mounted on cloth and folded in a stiff cover.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/- to 20/6
(1) Spanish	16/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	16/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 12 0	—
No. 1 Foundry	3 16 0	—
No. 3 Foundry	3 13 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 7 6	3 7 6
No. 1	3 8 0	3 8 0
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 6 0	—
„ „ Foundry	3 11 0	—
(c) Northampton—		
Foundry No. 3	3 7 6	—
Forge	3 2 6	—
(c) Derbyshire—		
No. 3 Foundry	3 11 0	—
Forge	3 6 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 1 6 (*a*); 4 3 6 (*b*); 4 8 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
LANCS.—		
Crown Bars	10 5 0	—
Second Quality Bars	8 15 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	10 5 0	—
Best Bars	11 0 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 15 0 to 10 7 6	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	8 15 0 to 9 0 0	—
Gas Tube Strip	10 17 6 to 11 0 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 10 0	10 0 0
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	8 0 0	8 0 0
Sheets (Gal. Cor. 24 B.G.)	11 7 6	11 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 15 0 to 7 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 2 6	—
SHEFFIELD—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	8 12 6 and 9 2 6	—
Intermediate Basic	7 2 6 and 7 12 6	—
Soft Basic	6 5 0	—
Hoops	10 5 0	—
Soft Wire Rods	7 15 0	—
MIDLANDS—		
Small Rolled Bars	7 2 6 to 8 0 0	—
Billets and Sheet Bars	5 5 0 to 5 15 0	—
Galv. Sheets, f.o.b. L'pool	11 0 0	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 2 6 to 9 5 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	15/3 to 15/6
Block Tin (cash)	119 5 0
„ (three months)	120 15 0
Copper (cash)	42 18 9
„ (three months)	43 12 6
Spanish Lead (cash)	12 1 3
„ „ (three months)	12 6 3
Spelter (cash)	11 12 6
„ (three months)	12 1 3
MANCHESTER—	
Copper, Best Selected Ingots	45 15 0
„ Electrolytic	46 10 0
„ Strong Sheets	77 0 0
„ Tubes (Basis Price), lb.	0 0 11
Brass Tubes (Basis Price), lb.	0 0 9¼
„ Condenser, lb.	0 1 0
Lead, English	13 17 6
„ Foreign	12 17 6
Spelter	12 5 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/3 per lb.	
Ferro Tungsten	2/- per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 0 0	7/-
„ „ 6 p.c. to 8 p.c.	£20 15 0	7/-
„ „ 8 p.c. to 10 p.c.	£20 10 0	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£32 0 0	10/-
„ „ „ 1 p.c. carbon	£35 0 0	12/-
„ „ „ 0·70 p.c. carbon	£37 0 0	14/-
„ „ „ carbon free	10d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 0 0 scale 5/- per unit	
„ „ 75 p.c.	£18 0 0 scale 7/- per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£170	
Ferro Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/6
„ „ Ell	15/6
„ „ Splint	15/6 to 16/6
„ „ Trebles	12/6
„ „ Doubles	11/9
„ „ Singles	10/3
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/6
„ „ Jewel	17/-
„ „ Trebles	13/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/- to 13/-
Screened Navigation	16/6 to 17/6
Trebles	12/- to 13/-
Doubles	11/6
Singles	10/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	13/-
Secondary Steam	12/9
Trebles	12/- to 13/-
Doubles	11/- to 11/6
Singles	10/-

ENGLAND.

(8) N.W. COAST—	
Steams	20/-
Household	30/- to 51/-
Coke	20/- to 20/6
NORTHUMBERLAND—	
Best Steams	13/6 to 14/-
Second Steams	12/- to 12/3
Steam Smalls	10/-
Unscreened	12/6 to 13/-
Household	27/- to 39/-
DURHAM—	
Best Gas	14/9 to 15/-
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	26/- to 28/

SHEFFIELD—	Inland.
Best Hand-picked Branch	25/6 to 27/-
Derbyshire Best Bright House	24/- to 26/-
Best House Coal	22/- to 23/-
Screened House Coal	19/6 to 20/6
„ „ Nuts	16/6 to 17/6
Yorkshire Hards	15/- to 16/6
Derbyshire Hards	15/- to 16/6
Rough Slacks	9/- to 10/-
Nutty Slacks	7/- to 8/-
Smalls	4/6 to 6/6
Blast-furnace Coke (Inland)	12/3 on rail at ovens
Furnace and Foundry Coke (Export), f.o.b. 14/- to 15/-	

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	20/- to 20/3
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 19/6
Ordinary Dry Large	17/9 to 18/-
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/6 to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/6 to 14/-
Ordinary Smalls	12/- to 13/6
Washed Nuts	18/- to 22/-
No. 3 Rhondda Large	19/9 to 20/3
„ „ Smalls	15/6 to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/- to 36/6
Furnace Coke (Export)	16/6 to 17/6
Patent Fuel	20/6 to 21/-
Pitwood (ex ship)	23/9 to 24/3
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	35/- to 37/6
Seconds	27/- to 31/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 45/-
Nuts	43/- to 46/-
Beans	24/9 to 28/3
Peas	19/9 to 21/6
Breaker Duff	8/9 to 9/6
Rubbly Culm	8/6 to 9/6
Steam Coals:	
Large	20/- to 21/-
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

The Mining Situation.

APART from the strikes and agitation caused by the communist groups in the Nord and the Pas de Calais, the colliers have generally accepted the temporary settlement arrived at by the coalowners and the Government whereby the notices for a wage reduction have been withdrawn pending an arrangement for giving to the companies special advantages that will enable them to compete with foreign coal. The Government has decided to restore the preferential reduction of 10f. a ton in the railway rates for coal to the ports which was granted to the coalowners two years ago under similar conditions and which was eventually withdrawn when it was found that the railway companies were losing money without materially benefiting the coalowners. Since then the situation of the railway companies has changed so much for the worse that it remains to be seen whether they will accept the sacrifice which the Government is trying to impose upon them. Another idea is to restrict the importations of dumped coal, particularly from Germany and Poland, but here again there are difficulties in the way, and it is by no means clear how the Government will relieve coalowners without causing trouble elsewhere. In its annual report the Comité Central des Houillères gives prominence to the difficulties under which coalowners are working with thin seams, which entail a smaller production per man than in other countries, and to many statistics designed to show the necessity of doing something to protect the industry.

Port Extensions.

The construction of the super liner at Saint-Nazaire for the Compagnie Générale Transatlantique, and the increasing traffic of Rouen to the detriment of Le Havre, have obliged the second-named port to push forward its programme of improvements which in time will enable Le Havre to receive the largest liners and deal with the heaviest traffic. The south breakwater is being removed and another will be constructed 200 m. outward in order to increase the width of the entrance to 250 m. and at the same time augment the area of the outer basin, which is at present 2500 m. long and 750 m. wide. The new breakwater will be 1200 m. long. The maritime station will be extended and the port equipment will be greatly improved. It already includes a dry dock 313 m. long and a 16,500-ton floating dock. The end of the basin will be widened to facilitate approach to the Tancarville Canal, which will be widened and deepened, the object of this work being to deal with much of the traffic that at present goes direct to Rouen. At La Pallice, near La Rochelle, work has started upon the new deep-water mole. This enterprise is the first item in a programme that aims at making La Pallice a port of call for Transatlantic liners and offering a direct route between Central and South America and Central Europe. It competes directly with the port of call being constructed at Le Verdon for Bordeaux.

The Navy.

The question of man power for the navy is becoming every year more difficult of solution, for the reason that the men are drawn normally from a conscript army and from the maritime population, all those engaged in a seafaring occupation being naturally declared as conscripts for the navy. The number of sea-going conscripts, however, is falling away steadily, and now that the military service is being reduced until at the end of the present year the period of service will be only two years, there is insufficient time to make a landsman into a sailor. Special advantages have been offered for voluntary enlistment, with the result that while the conscript contingent has diminished considerably the number of voluntary enlistments has risen from 12,266 in 1927 to 21,217 in 1930. There was also an increase in the number of men signing on for further periods. In the two years named the number of men passing into the navy, both voluntary and conscript, was 50,866 and 55,417 respectively, so that the voluntary system is contributing something to the ranks of the naval services.

Paris Water Supply.

The intention of the Paris Municipal Council to start upon the works for bringing water from the Vals de Loire during the present year seems likely to be fulfilled in view of the arrangement that has just been come to with the Conseil Général du Département du Loiret. Already a settlement had been made with the Department of Cher, so that the solid opposition that had existed to the Paris scheme was broken through, and the Conseil Général du Loiret had to make the best terms it could. The trouble has always been the fear of the population in the Loire Valley that the drawing of a million cubic metres of water a day for the requirements of Paris would eventually exhaust the underground supplies and ruin prosperous local industries. An expert inquiry showed that such a contingency was highly improbable, but the Paris municipality undertook to take every possible precaution in the way of creating barrage reservoirs to regulate the water level in the Loire. This plan does not satisfy the Conseil Général du Loiret, which has given its adhesion to the scheme by accepting the 7,500,000f. offered by the Paris municipality, and claims, further, a subsidy of one centime per cubic metre of water drawn from the subterranean supply.

Marsh Land Drainage.

There are several schemes for draining the marsh lands that exist along the wide coastal belt between the mouths of the Gironde and the Loire. Another proposal of a different type is for the drainage of a large area behind the Bay of Audierne, in Finistère, which is protected by sand dunes that prevent the flow of fresh water from the marshes to the sea. As an experiment a concrete aqueduct was constructed through the dune with an automatic valve and a sluice gate that may be closed in case of emergency. At low tide the valve opens to allow the water to drain into the sea and with the rising tide the valve closes automatically. The result was so far satisfactory that landowners along the coast have combined to carry through, with the aid of the State, a complete system of drainage on this principle.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

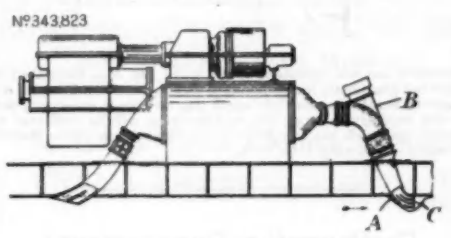
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

CONDENSERS AND FEED-WATER HEATERS.

343,823. April 25th, 1930.—MARINE CONDENSERS, The Westinghouse Electric and Manufacturing Company, East Pittsburg, Pennsylvania.

This invention is concerned with the more or less familiar idea of scooping water from beneath a ship and passing it through the condenser for cooling purposes. The inventors suggest that such schemes, as at present known, interfere with the structural strength of the ship. They consequently arrange the

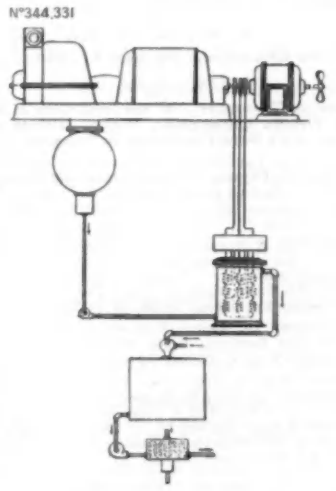


inlet from the scoop A at a steep angle, so that it will clear the framing. At the mouth of the scoop there are guide vanes which minimise eddying. The inlet is divergent for the purpose of converting the velocity energy of the water into pressure, to overcome the frictional resistance of the condenser tubes. The pump B is, presumably, installed for circulating water when the vessel is not under way. The scoop is provided with guards C.—*February 26th*, 1931.

TURBINE MACHINERY.

344,331. August 7th, 1930.—TURBO-ELECTRIC MARINE PLANT, *The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C. 2.*

If it is desired to obtain a wide variation in speed of the propeller motor of a turbo-electric drive, and, incidentally, employ A.C. machinery, it is necessary to install a large rheostat for

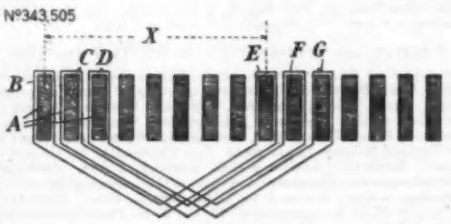


regulating purposes. This rheostat must be cooled to absorb the power that must be dissipated at less than full speed, and the energy would, normally, be wasted. The inventors, consequently, cool the rheostat by passing through it the condensate from the main condenser, and thus return to the feed water the heat that would otherwise be lost. The drawing is self-explanatory.—*March 5th*, 1931.

DYNAMOS AND MOTORS.

343,505.—November 13th, 1929.—DYNAMO-ELECTRIC MACHINES, The British Thomson-Houston Company, Limited, of Crown House, Aldwych, London, W.C. 2, and Frank Percy Whitaker, of 237, Clifton-road, Rugby.

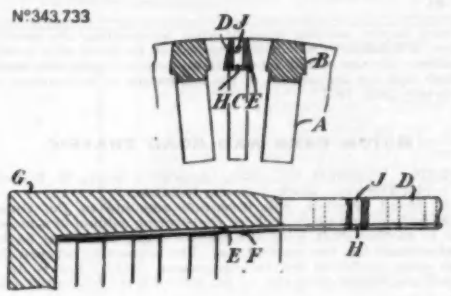
According to this invention, an equaliser winding consists of coils wound on the teeth of the armature, the coils surrounding



teeth one or two pole pitches apart being connected together, so that normally there is no induced electromotive force, and therefore no circulating current. Referring to the drawing, the teeth A of the armature are surrounded with coils B C D, &c., and the coils on teeth which are a pole pitch apart are connected together, so that normally there is no induced electromotive force. Thus, if X represents the pole pitch, the coils B and E, C and F, D and G are connected together.—*February 12th*, 1931.

343,733. February 12th, 1930.—ELECTRIC A.C. GENERATORS The Brush Electrical Engineering Company, Ltd., of Falcon Works, Loughborough, and Charles Cecil Sutton, of the same address.

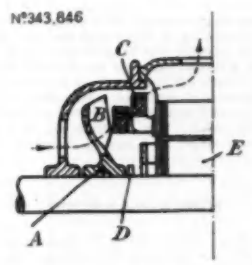
This invention relates to electric A.C. generators, and it has for its object to provide an improved rotor for high-speed alternators. According to the invention, the advantages of the customary damping winding are secured by a construction which differs from existing arrangements in that the strips or bars, mechanically continuous from end to end of the rotor, and employed to constitute a squirrel-cage structure, are not



placed in the slot which accommodate the main field coils, but in interslots. The main winding slots A are closed by steel wedges B, the interslots being designated C and closed by copper wedges D. One of the bars which in accordance with the invention is arranged in a corresponding slot C is shown at E, and is extended to lie upon insulation F previously compressed by a dummy cap. The end cap proper G is of metal, and is driven directly on to the bars E collectively, so as to produce the required squirrel-cage structure. As the interslots C are intended for ventilation purposes, the bars E and wedges D are respectively formed with radial holes H and J.—*February 26th*, 1931.

343,846. May 26th, 1930.—ELECTRIC INDUCTION MOTORS, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

The object of this invention is to enable an induction motor to be efficiently cooled at low rotor speeds, so that the heat produced by the starting current may be carried off satisfactorily without damage to the motor. The hub A of the fan is rotatably mounted on the motor shaft. The blades B of the fan consist of iron or other magnetic material, and are exposed to the leakage field of the stator winding C. On the motor shaft there is a

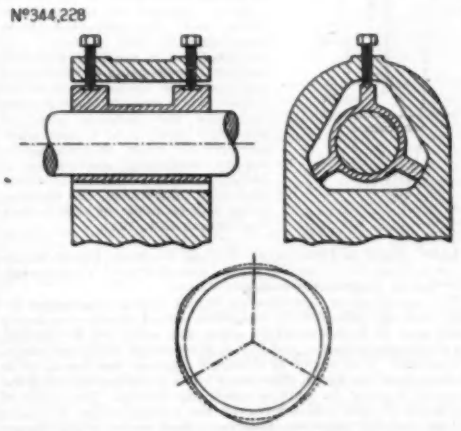


collar D, which, on the side facing the fan, is provided with teeth serving as a locking device, the hub A of the fan being likewise provided with corresponding teeth. The locking device thus constituted acts so that the fan may move relatively to the rotor E in one definite direction only, so that when the motor, after running for the starting period, has attained its normal speed, the fan is carried round by the rotor shaft. On switching on the motor, the leakage field acts directly on the fan blades B, so that the latter are at once given a high speed.—*February 26th*, 1931.

TRANSMISSION OF POWER.

344,228. March 6th, 1930.—SHAFT BEARINGS, O. Mackensen, Riemannstrasse 2, Jena, Germany.

In order to improve the lubrication of journal bearings, the inventor forms the bearing as a sleeve or bush with a clearance on the shaft. This bush is provided with three sets of lugs, as



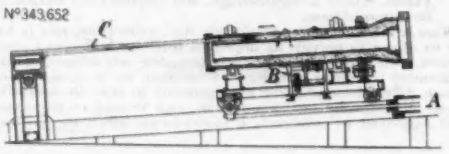
shown in the cross-section, that carry the load to the housing. One set of the lugs, such as that at the top, may be compressed by set screws. The result is that the bush is deformed, as shown in an exaggerated manner, and three wedge-like spaces are formed for the introduction of lubricant between the journal and the bearing.—*March 5th*, 1931.

MACHINE TOOLS AND SHOP APPLIANCES.

343,652. December 18th, 1929.—STRIPPING CAST PIPES FROM THEIR MOULDS, A. Possenti, 29, Lungomare Nazzario Sauro, Pesaro, Italy, and C. Scorza, 159, Via Andrea Costa, Pesaro.

It would appear that this machine is specially applicable to

stripping centrifugally cast pipes from their moulds, but might be used for pipes cast by other processes. The mould is mounted between rollers on an inclined carriage, and is lowered down the slope by a hydraulic ram A. It is rotated by the gear B. Pre-

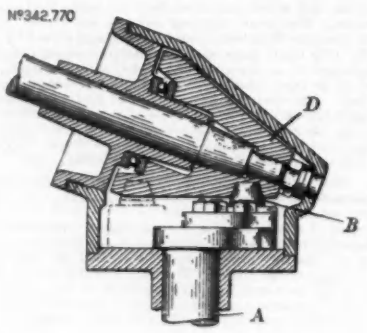


sented to the annular mass of sand representing the mould, there is a lance C, which is furnished at its head with rotary cutters. As the mould rotates these cutters loosen the sand, which falls out on account of the inclination of the carriage.—*February 26th*, 1931.

MOTOR CARS AND ROAD TRAFFIC.

342,770. November 8th, 1929.—Steering Gear, R. Bishop, 145, The Vale, Golder's Green, Middlesex.

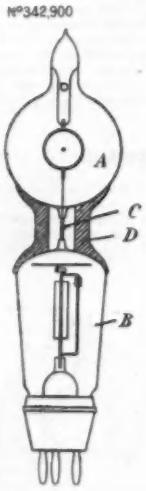
In broad principle, this invention amounts to the transmission from one shaft, such as the steering column of a motor car, to another shaft, lying at a relative angle, which may be the rocker shaft A of the steering gear. The connection between the two parts is effected by the engagement of the roller B on a crank arm, with a scroll-shaped groove cut in the face of the cone



D fixed on the steering column. It is suggested in the specification that "the mounting of the roller directly on the arm and carrying the arm beyond the longitudinal axis of the conical member permits a larger range of movement and at the same time has greater length when considered as a lever in comparison with the usual worm and sector or worm and nut mechanism of the same size, whereby working pressures are reduced and plain bearings may be used. The mechanism is compact, easily assembled and contained in a casing of small dimensions."—*February 9th*, 1931.

MISCELLANEOUS.

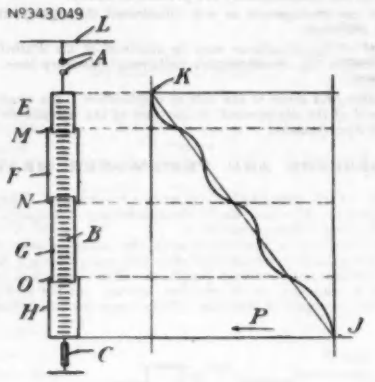
342,900. February 5th, 1930.—A Combined Thermionic Valve and Photo-electric Cell, Lissen, Ltd., of Lissenium Works, Worple-road, Isleworth, Middlesex, and Richard Percy Richardson, of the same address.



This specification describes a combined thermionic valve and photo-electric cell. The cell A is attached to the top of the thermionic valve B. Wires C attached to the electrodes to be electrically connected are sealed through the respective bulbs and connected together. The junction member or distance piece D is cupped at its ends to fit the respective bulbs. It is initially made in two parts divided along an axial plane. After the wires C are joined the two parts of the distance piece are brought together and secured by a spring clip or other fastening or cemented along their contacting edges. The two bulbs are thus held apart in a definite relative position by the distance piece, and are prevented from separating by the electrical connection C which ties them together, and by the cementing of the cupped surfaces of the distance piece to the bulbs. As a rule, it is convenient to make the distance piece of synthetic resin; but it may alternatively be made of porcelain or similar insulating material or of metal. Where avoidance of vibration is of importance, the distance piece may be made of soft rubber.—*February 12th*, 1931.

343,049. October 11th, 1929.—Excess Voltage Dischargers for High Working Voltages, Emil Pfiffner, of Hirschthal, Canton Aargau, Switzerland.

This specification describes an excess voltage discharger for high working voltages. A designates an adjustable regulating spark gap, B is the multiple spark gap structure or column, C a damping resistance, and E F G H represent condenser plates or coatings. The device is arranged between the line L to be protected and the earth. The wavy line J K shows the rise of the potential P along the multiple spark gap column. The course of the potential line J K determines the extent of the operative voltage and the maximum working voltage under which the arc is positively extinguished or quenched, and it depends essentially on the size of the electrodes, their distance apart from one another and the size of the capacities formed by the overlapping parts of the plates. The plates overlap one another at M, N, and O. The overlapping parts of the plates E F form a condenser which is in series with other condensers formed by the overlapping parts of the plates F G and G H, these condensers forming together the equivalent of a single condenser connected in parallel with the multiple spark gap column. The regulating spark gap A is carried by an insulator, the surface resistance of which depends on atmospheric conditions. This insulator thus constitutes a high resistance leakage path in parallel with the spark gap A, the value of resistance of which depends mainly on the moisture deposited on it. If the capacity of the multiple spark gap is small, then only a small charging current flows along the leakage path and the voltage drop across the leakage path and therefore across the spark gap A is also very small, so that the spark gap acts less readily in damp weather and a higher voltage is required to operate the spark gap in wet weather than in dry weather. The voltage drop across the leakage path is



increased and the operation of the spark gap A is facilitated or rendered practically independent of atmospheric conditions if the capacity across the multiple spark gap column is increased, and if this capacity is large, the voltage drop will be sufficient to enable the spark gap to operate even when the insulator thereof is damp.—*February 11th*, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London, S.W. 1. Informal meeting. Discussion on "Aerial Ropeways," to be introduced by Mr. Harrison Roe. 7 p.m.

Junior Institution of Engineers.—39, Victoria-street, Westminster, London, S.W. 1. "Difficulties in Power Transmission by Belt and how to Overcome Them," by Mr. F. Russell. 7.30 p.m.

Railway Club.—57, Fetter-lane, E.C. 4. "Light Railways and their Future," by Mr. D. S. Berrie. 7.30 p.m.

TO-DAY to SATURDAY, MAY 2nd.

Ideal Home Exhibition.—Olympia, W. Daily.

MONDAY, APRIL 13th.

Institute of Transport.—At the Institution of Electrical Engineers, Victoria Embankment, W.C. 2. Debate upon the Final Report of the Royal Commission on Transport. 5.30 p.m.

Institution of Electrical Engineers: North-Eastern Centre.—In the Physics Theatre, Armstrong College, Newcastle-on-Tyne. Annual general meeting. 7 p.m. "The New Automatic Telephone System on Tyneside," by Mr. F. G. C. Baldwin. 7.30 p.m.

Institution of Electrical Engineers: South Midland Centre.—At the University, Edmund-street, Birmingham. Annual general meeting. "Recent Progress in Large Transformers," by Mr. R. M. Charley; and "The Application of the Induction Voltage Regulator," by Mr. W. E. M. Ayres. 7 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Howard Lectures, "The Present Position in Aeronautics," by Dr. N. A. V. Piercy. 8 p.m.

Society of Chemical Industry: London Section.—In the Chemical Society's Rooms, Burlington House, W. 1. "Studies in the Free Air Cooling of Hot Gases in Mains," by Mr. J. A. Walters; and a paper by Mr. F. L. Bassett, of Baghdad, on "Some Factors Affecting the Corrosion of Buried Steel," will be read by Mr. Butterfield. 8 p.m.

TUESDAY, APRIL 14th.

Institute of Marine Engineers.—The Minories, London, E.C. 3. "The Caprotti-Bauer-Wach Marine Installation," by Mr. F. A. Pudney. 6 p.m.

Institution of Civil Engineers.—Great George-street, Westminster, S.W. 1. Discussion, "The 132-kV Transmission System of the Central Scotland Electricity Scheme," by Mr. R. W. Mountain; and "The Deptford West Power Station of the London Power Company, Ltd.," by Mr. C. S. Berry, Mr. H. P. Gaze, and Mr. C. E. H. Verity. 6 p.m.

Institution of Electrical Engineers.—In the Engineers' Rooms, 39, Elmbank-crescent, Glasgow, C. 2. Annual general meeting. "The Medical and Surgical Applications of Electricity," by Dr. Bernard Leggett. 7.30 p.m.

Institution of Electrical Engineers: North Midland Centre.—The Hotel Metropole, Leeds. Annual general meeting. Smoking concert. 7 p.m.

Manchester Geological and Mining Society.—Queen's Chambers, 5, John Dalton-street, Manchester. The following paper will be read and discussed, "Some Safety Problems which Arise when Taking a Bulk Supply of Electricity," by Mr. J. A. B. Horsley. 4 p.m. The Council will meet at 3 p.m.

TUESDAY and WEDNESDAY, APRIL 14th and 15th.

Society of Glass Technology.—King's Head Hotel, Sheffield. Glass Standards Committee meeting, 6 p.m.; informal dinner, 7 p.m.; Council meeting, 8.15 p.m. Wednesday, visit to the Brown-Firth Research Laboratories, Sheffield, 10 a.m.; luncheon, King's Head Hotel, Sheffield, 12.30 p.m. In Room C4, the Applied Science Department, The University, St. George's-square, Sheffield. Annual general meeting, 2 p.m. Ordinary general meeting. To receive and discuss the following papers:—"Studies of Clay Mixtures for Glass Melting Pots," Part III., "Creep at High Temperatures," by Dr. J. H. Partridge and Mr. G. F. Adams; "A Study of the Formation of Glass," by Dr. J. T. Howarth and Professor W. E. S. Turner. 2.30 p.m.

WEDNESDAY, APRIL 15th.

Institution of Civil Engineers.—Great George-street, Westminster, S.W. 1. Students' meeting. "Some Considerations on the Economic Design of Small Reinforced Concrete Girder Bridges for Highway Use," by Mr. F. C. Ball. 6.30 p.m.

Newcomen Society.—Prince Henry's Room, Fleet-street, London, E.C. 4. The meeting concluding the session will take place simultaneously in London and New York. "The First Installation of House-to-house Supply in the United Kingdom," by Colonel R. E. B. Crompton; "The Pearl-street Station: The First Steam Power Station in America," by Mr. George A. Orrok; "The Civil Engineering Achievements of John B. Jervis," by Professor James K. Finch. 5.30 p.m.

Royal Meteorological Society.—49, Cromwell-road, South Kensington, S.W. 7. Meeting at 5 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "Industrial Lighting," by Mr. D. R. Wilson. 8 p.m.

THURSDAY, APRIL 16th.

Institution of Electrical Engineers.—In the Lecture Theatre of the Institution, Savoy-place, Victoria Embankment, W.C. 2. "Recent Progress in Large Transformers," by Mr. R. M. Charley; and "The Application of the Induction Voltage Regulator," by Mr. W. E. M. Ayres. 6 p.m.

Royal Aeronautical Society.—At the House of the Royal Society of Arts, John-street, Adelphi, London, W.C. 2. "Noise," by Dr. A. H. Davis. 6.30 p.m.

FRIDAY, APRIL 17th.

Institute of Metals: Sheffield Local Section.—In the Non-Ferrous Section of the Applied Science Department of the University, St. George's-square, Sheffield. "Extrusion," by Mr. R. Genders. 7.30 p.m.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London, S.W. 1. "Post-war Land Turbine Development," by Mr. C. D. Gibb. 6 p.m.

Institution of Municipal and County Engineers: North-Western District.—Meeting. Assemble at Victoria Station, Manchester, 9.30 a.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. "The Transmission of Gas," by Mr. J. E. Gray; "The Building Requirements of Lifts," by Mr. T. G. Martin. 7.30 p.m.

FRIDAY and SATURDAY, APRIL 17th and 18th.

Faraday Society.—The Department of Chemistry, The University, Liverpool. General discussion on "Photochemical Processes." I.: "Molecular Spectra in Relation to Photochemical Change," Friday, 10 a.m., introductory paper by Professor R. Mecke; II.: "Photochemical Kinetics in Gaseous Systems," Friday, 2.30 p.m., introductory paper by Professor M. Bodenstein; III.: "Photochemical Change in Liquid and Solid Solutions," Saturday, 10 a.m., introductory paper by Professor Berthoud; IV.: "Photosynthesis," Saturday, 2.30 p.m., introductory paper by Professor E. C. C. Baly.

SATURDAY, APRIL 18th.

Institution of Municipal and County Engineers: Yorkshire District.—Meeting at Sowerby Bridge. 2 p.m.

MONDAY, APRIL 20th.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Howard Lectures, "The Present Position in Aeronautics," by Dr. N. A. V. Piercy. 8 p.m.

WEDNESDAY, APRIL 22nd.

Institution of Mining and Metallurgy.—Edward VII. Rooms, Hotel Victoria, Northumberland-avenue, London, W.C. 2. Annual dinner. 7.15 for 7.45 p.m.

FRIDAY, APRIL 24th.

Junior Institution of Engineers.—At the Hotel Metropole, Northumberland-avenue, London, W.C. 2. Annual dinner.

MONDAY, APRIL 27th.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Howard Lectures, "The Present Position in Aeronautics," by Dr. N. A. V. Piercy. 8 p.m.

WEDNESDAY, APRIL 29th.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "Stainless Metals," by Professor Sir Harold Carpenter, F.R.S. 8 p.m.

THURSDAY, APRIL 30th.

Diesel Engine Users Association.—Caxton Hall, Westminster, S.W. 1. "Notes on the Operation of Heavy Oil Engines," by Mr. Geoffrey Porter. 3.30 p.m.

FRIDAY, MAY 1st.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London, S.W. 1. Informal meeting. Discussion on "Hydraulic Valves," to be introduced by Mr. Henry Crowe. 7 p.m.

National Institute of Industrial Psychology.—In the Hall of the Royal Society of Arts, John-street, Adelphi, London, W.C. 2. "The Causes of Juvenile Drifting," by Miss S. Bevington; "*Personnel* Work in Modern Industry," by Mr. A. H. Seymour. 6 p.m.

SATURDAY, MAY 2nd.

Institution of Electrical Engineers: Meter and Instrument Section.—Visit to Cambridge, by invitation from the directors of the Cambridge Instrument Company, Ltd., and Professor C. E. Inglis, F.R.S., of the Engineering Laboratory of Cambridge University. 8.30 a.m., leave Liverpool-street Station; 10.30 a.m., arrive at the works, demonstrations will be arranged by the company; 12.45 p.m., lunch as the guests of the company; 2 p.m., visit places of interest in Cambridge, including some of the colleges, the Backs, and the river; 4.30 p.m., tea at the Engineering Laboratory, Cambridge, by invitation of Professor Inglis, inspect the Laboratory; 7.10 p.m., leave Cambridge by train.

WEDNESDAY, MAY 6th.

Institute of Metals.—In the Hall of the Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. Annual May Lecture, "Progress of Power Production," by Mr. W. B. Woodhouse. 8 p.m.

THURSDAY and FRIDAY, MAY 7th and 8th.

Iron and Steel Institute.—At the Institution of Civil Engineers, Great George-street, Westminster, S.W. 1. Annual meetings. 10 a.m. each day.

FRIDAY, MAY 8th.

Institution of Electrical Engineers.—The Foresters' Hall, Nicol-street, Dundee. Faraday Lecture, "The Birth of Electrical Engineering," by Professor W. Cramp. 7.30 p.m.

SATURDAY to SUNDAY, MAY 30th to JUNE 14th.

Institute of Transport.—Italian Tour and Congress. For provisional programme see page 359.

MONDAY to FRIDAY, JUNE 1st to 5th.

International Federation for Housing and Town Planning.—Berlin. Thirteenth International Housing and Town Planning Congress.